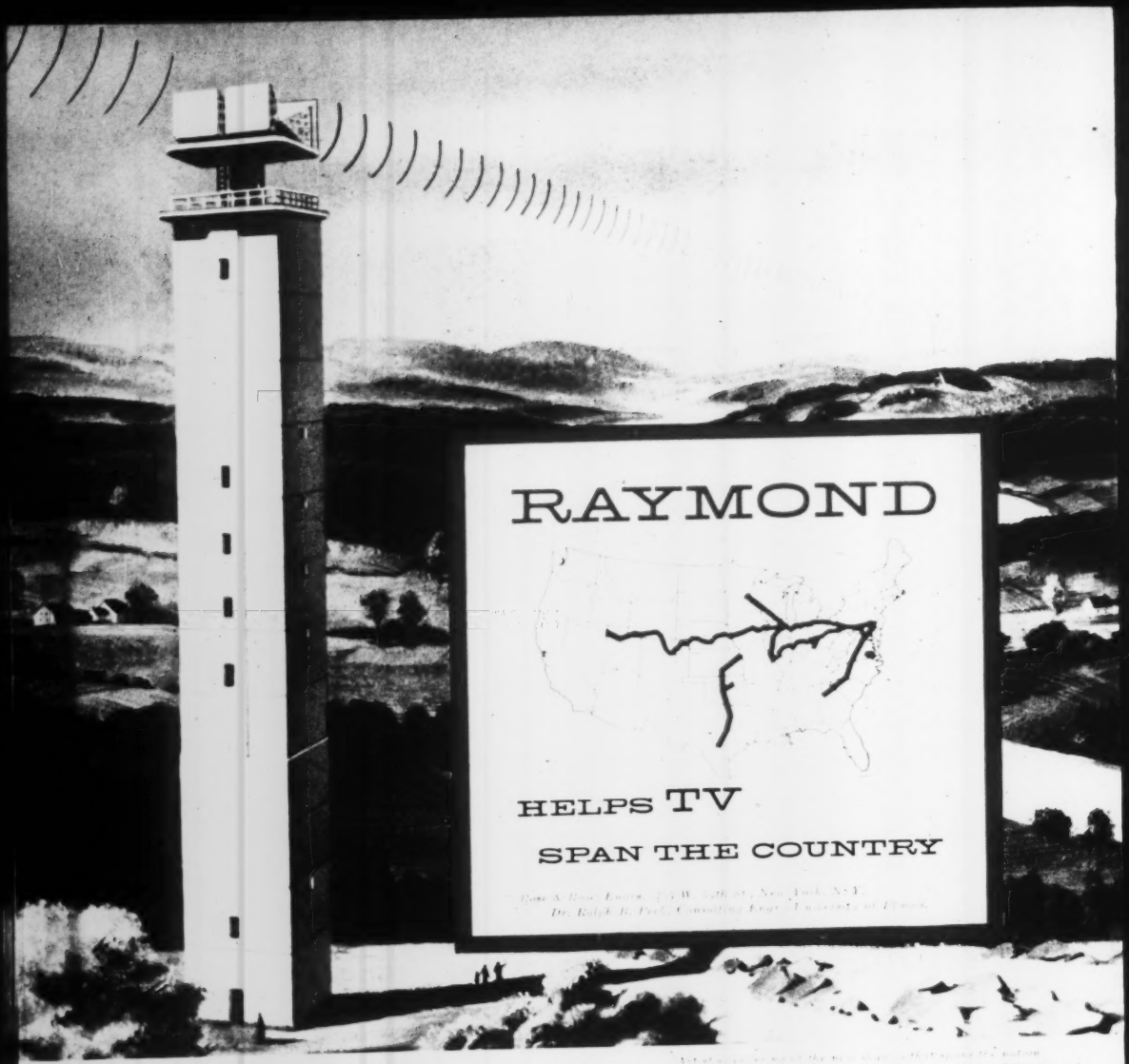
CIVIL ENGINEERING

NIKKATSU INTERNATIONAL BUILDING, TOKYO

is sunk by open caisson method.

see article by Arnold C. Mason



Completing another job in record time, the Gow Division of Raymond conducted test borings and made soil investigations for over 150 locations of A. T. & T.'s radio-relay towers which carry television across a major portion of the country. In the accomplishment of this work, Raymond personnel and technique once again played an important part in an outstanding achievement.

RAYMOND

CONCRETE PILE CO.

140 Cedar Street • New York 6, N. Y.

Branch Offices in the Principal Cities of United States and Central and South America

"... the 99-H is the most versatile grader I have ever seen, as well as the most maneuverable."

"This grader is on U.S. Route 35, where we are engaged in a project involving 2.05 miles of grading, draining and ditching, as well as paving the highway in North Charleston between Two Mile Creek and Tyler Creek.

"This is the first Austin-Western grader to be used in this family of contractors, and I have no hesitancy in saying that the 99-H is the most versatile grader I have ever seen, as well as the most maneuverable. It will do jobs that other graders will not do, and, when the going is really tough, it will operate under conditions that other graders would not attempt. Just recently, after several days of heavy rain, the 99-H was doing its chores on schedule. Two other graders of well-known makes were compelled to stand by until the terrain was favorable to the extent that they could be put to work. This adds up to more hours operation every week for the 99-H.

"Aside from the standpoint of the 99-H's ability to take tough going in stride, it is also the easiest grader to operate that I have ever owned. The operators like it, which means we get more efficiency from them."

HOWARD PRICE AND COMPANY
Howard Price
President

Howard Price, President
Howard Price and Company
Huntington, W. Va.

Thank you, Mr. Price, for putting into words—what so many other contractors have learned—that Austin-Western's *exclusive* combination of ALL-WHEEL DRIVE and ALL-WHEEL STEER means top grade performance by America's top grader.

AUSTIN-WESTERN COMPANY · *Subsidiary of Baldwin-Lima-Hamilton Corporation* · **AURORA, ILLINOIS, U.S.A.**

BALDWIN BLH LIMA-HAMILTON

Austin-Western

CIVIL ENGINEERING, The Magazine of Engineered Construction, November, 1952. Vol. 22, No. 11. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.50 a year in advance; $4.00 a year to members and to libraries and $2.50 a year to members of student chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second-class matter September 25, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

HIGHWAY BRIDGES

Superstructures

Foundations

COAST TO COAST CONSTRUCTION FROM THREE STRATEGICALLY LOCATED PLANTS

PITTSBURGH • DES MOINES

Tallassee, Ala. Tallapoosa River Bridge consisting of six 178' and one 300' continuous truss spans curved and superelevated, with 26' roadway and two 4' sidewalks.

Caribou, Maine. Aroostook River Bridge. Four 75' spans, one 250' cantilever span, two 175' anchor spans—with 28' roadway and two 4' walks.

Allegheny County (Pittsburgh), Pa. Dooker's Hollow Bridge. Total length 598'—consisting of two 69' cantilever arms and one 138' suspended span between piers and two 161' anchor spans.

A complete bridge construction service is provided by Pittsburgh-Des Moines including pneumatic and open caisson foundations, cofferdams, movable and fixed steel spans, concrete sub- and superstructures, viaducts and underpasses. Let us quote on your requirements!

PITTSBURGH•DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

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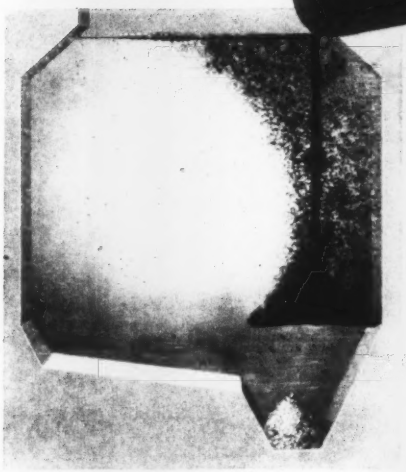
NEWARK (2) . . . . 251 Industrial Office Bldg.	DALLAS (1). 1275 Praetorian Bldg.
CHICAGO (3). 1274 First National Bank Bldg.	SEATTLE . . . . . 578 Lane Street
LOS ANGELES (48). . . . . 6399 Wilshire Blvd.	SANTA CLARA, CAL. . 677 Alviso Road

CHICAGO SEWAGE EQUIPMENT

Chicago AER-DEGRITTER



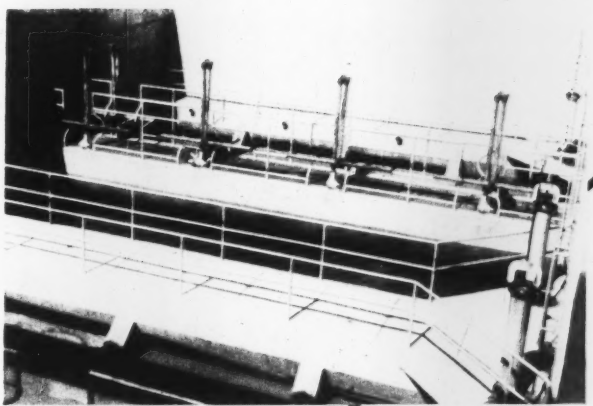
The only method of removing grit and sand from sewage without mechanical equipment is provided by the Chicago Aer-Degritter. The velocity of flow is controlled by air introduced through Chicago Swing Diffusers and Precision Diffuser Tubes. All sand of 0.2 mm. (65 mesh) and larger is washed and deposited in the bottom of the tank.

Less than 10% volatile matter and only a negligible trace of putrescible organics remains in the grit removed. Aer-Degritters may be installed ahead of all mechanical equipment because coarse sewage material will not interfere with the operation of the Aer-Degritter or affect the hydraulic design of the plant.

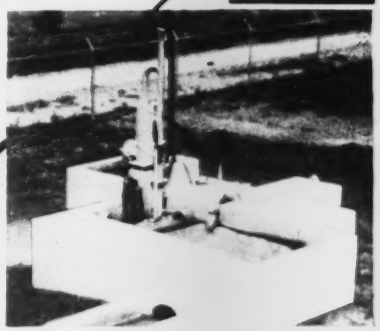
Here are the basic features of the Chicago Aer-Degritter.

- MAXIMUM REMOVAL
- CLEAN GRIT
- NO MECHANISM
- LOW COST
- SIMPLE STRUCTURE
- AIR CONTROLLED VELOCITIES INDEPENDENT OF FLOW

52 INSTALLED IN TWO YEARS



COLUMBUS OHIO SEWAGE TREATMENT PLANT
Design Flow 160 M.G.D.
PAUL A. UHLMANN & ASSOCIATES
Consulting Engineers

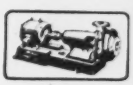


BELLAIRE, TEXAS SEWAGE TREATMENT PLANT
Design Flow 8 M.G.D.
HILTON & COULSON
Consulting Engineers

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

622 DIVERSEY PARKWAY — **CHICAGO 14, ILLINOIS**



Flush Kleen, Scru-Peller, Plunger Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers.

Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A. N. A.

PIPE LINE CREWS encounter all kinds of conditions from deep woods to the congested streets in the heart of a large city's business district. This cast iron pipe installation could be either a water supply line from a mountain reservoir or a sewer force main leading to a remote treatment plant. If it were a gas transmission line it would, of course, be mechanical joint pipe.

U. S. cast iron pipe in sizes from 2-inch through 24-inch are cast *centrifugally* in metal molds with bell-and-spigot, mechanical joints and plain ends. The *pit cast* process is used in producing all sizes of flexible joint and flange pipe as well as all pipe 30-inch and larger. Highly developed production controls guard the uniformly high quality of U. S. Cast Iron Pipe.

United States Pipe and Foundry Co.,
General Offices, Burlington, N. J.
Plants and Sales Offices Throughout the U. S. A.

U.S.
cast iron
PIPE
FOR WATER, GAS, PETROLEUM AND INDUSTRIAL SERVICE

Cutting ditching hazards on the high seas and the highways

U·S·S AMERICAN MULTISAFTY CABLE GUARD

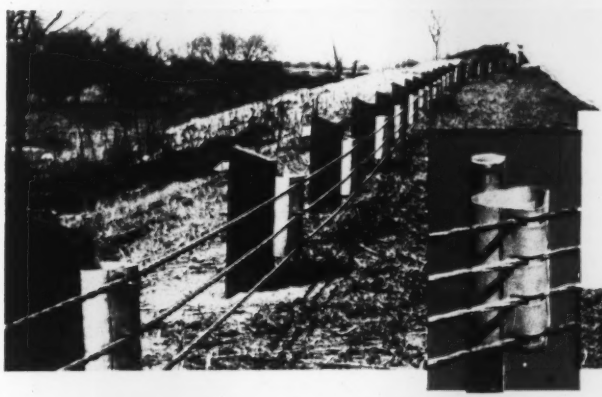
THE LANDING OFFICER can guide the pilot to the air-craft carrier's deck, but he cannot *stop* the plane. To do that, a hook, attached to or near the plane's tail must engage one of the galvanized wire cables mounted on spring brackets, which are stretched across the deck. The resiliency of the wire cable, plus the action of the spring bracket, absorbs the shock of the plane's forward speed, helps stop it promptly, safely. American Multisafty Cable has proved so long lasting, effective and economical that it is being widely used for this purpose by the United States Navy.

WHEN a pilot lands his fighter on a flattop, a system of wire cables, attached to spring brackets, prevents him from "ditching" at the other end of the ship. And when a motorist goes off the road on a properly protected highway, a system of wire cables, attached to resilient brackets, can be designed to properly deflect the car even though the guard rail is hit at high speeds.

That is why Multisafty Cable Guard has been adopted as a standard material by many state highway commissions. The four galvanized wire cables, attached to galvanized spring brackets, absorb the impact of collision and sideswiping, prevent off-the-road crashes and capsizing of speeding cars.

Multisafty Cable Guard has been developed from many tests made at our Worcester, Massachusetts proving grounds where various guard rails were hit by automobiles at high speeds. Stresses in the rail were measured at time of impact. From these tests, data are now available to arrive at a rational method of designing highway guard for *definite miles per hour protection*.

When you are considering high-grade low-cost protection for highway traffic in your area, drop a line to our nearest sales office for complete information on Multisafty Cable Guard and for literature containing information on how to design a guard rail for *definite miles per hour protection*.



THE FOUR GALVANIZED wire cables of Multisafty Cable Guard possess the tremendous strength needed to withstand terrific impact. The offset spring brackets on which the cables are mounted help to absorb impact stresses and to deflect vehicles which collide with the guard. Posts and anchorages are sufficiently sturdy to withstand the total stresses transmitted by cables and springs. No painting is required, therefore, upkeep costs are low.

AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL COMPANY, GENERAL OFFICES: CLEVELAND, OHIO

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS

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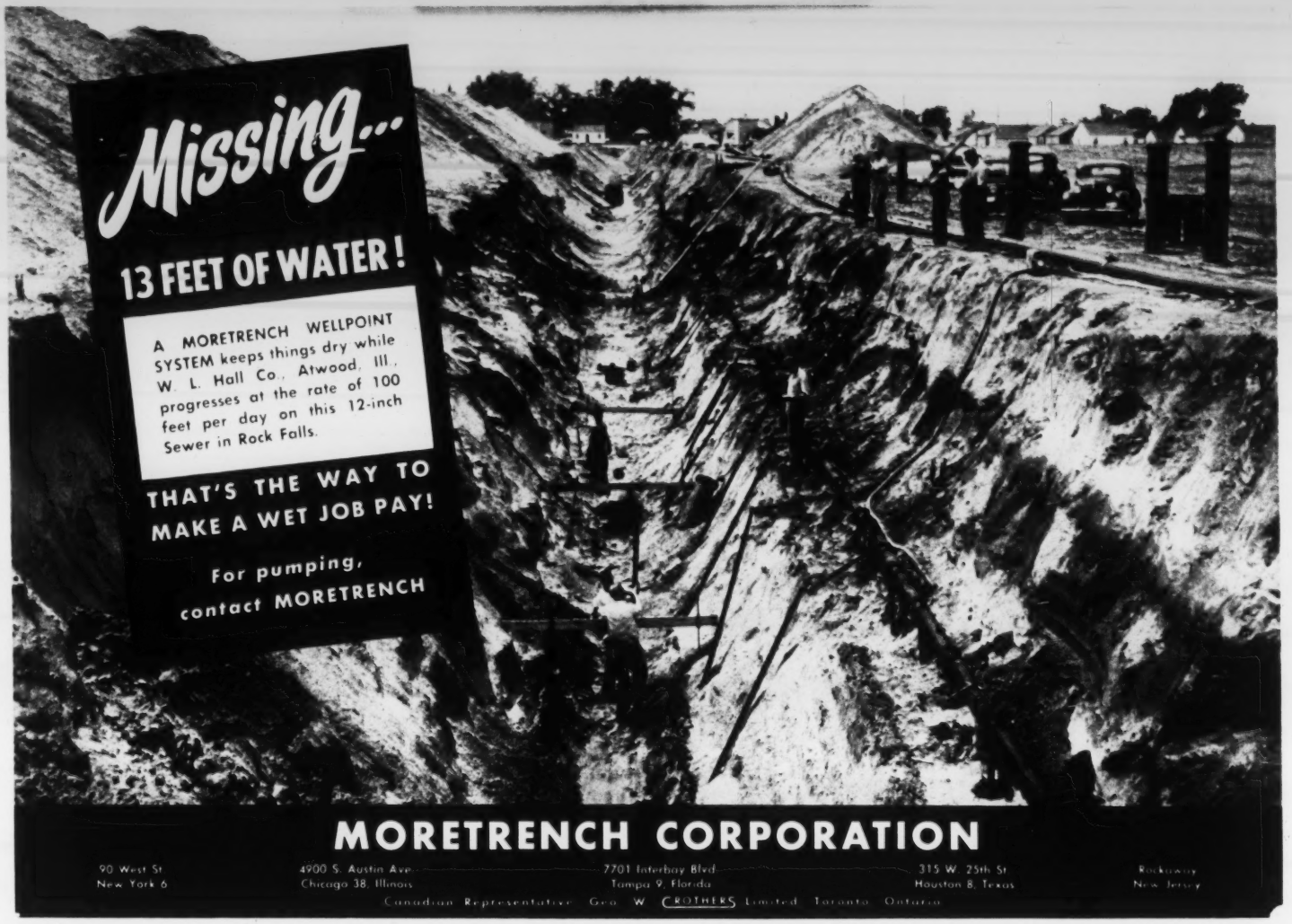
USS

UNITED STATES STEEL


Missing...
13 FEET OF WATER!
A MORETRENCH WELLPOINT SYSTEM keeps things dry while W. L. Hall Co., Atwood, Ill., progresses at the rate of 100 feet per day on this 12-inch Sewer in Rock Falls.
THAT'S THE WAY TO MAKE A WET JOB PAY!
For pumping, contact MORETRENCH
MORETRENCH CORPORATION
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315 W. 25th St. Houston 8, Texas
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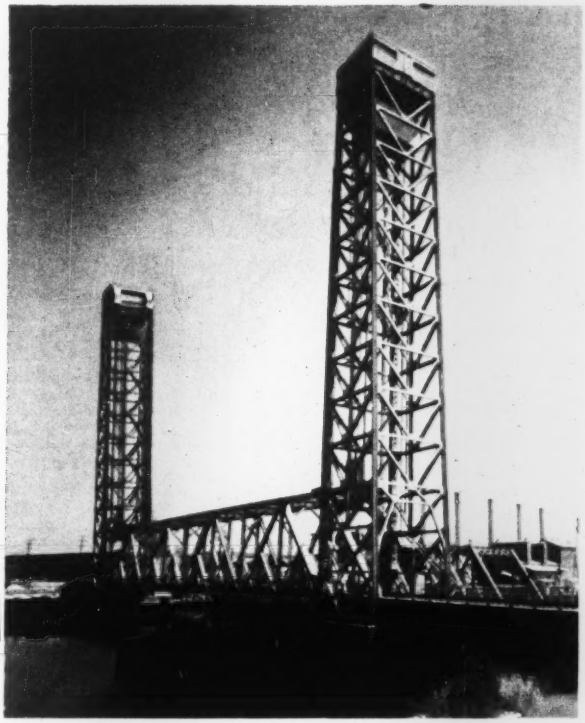
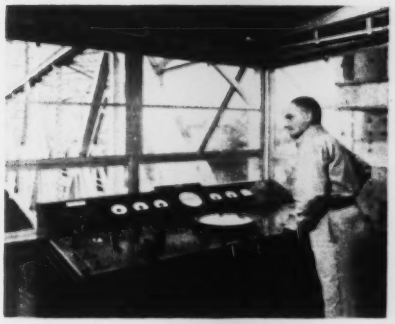
Canadian Representative: Geo. W. CROTHERS Limited Toronto Ontario



AMPLIDYNE CONTROL first applied to movable bridges by G.E. permits raising and lowering Oakland's new Fruitvale bridge in a shorter time than by any other method. Amplidyne control responds instantly, provides faster acceleration and deceleration.



BRIDGE OPERATION is centered in operator's console. Amplidyne's closer control keeps ends of span aligned during operation, "seats" bridge accurately and smoothly.

REDUCED STRESS ON BRIDGE structure and machinery results from torque limiting, inherent in amplidyne control. Photo shows part of G-E drive equipment in east tower.

Smooth, pinpoint control speeds bridge operation

G-E amplidyne-controlled drive prevents skewing, seats span faster, protects structure from shocks

Key to precise control, faster operation, and better equipment protection of Oakland's new Fruitvale Avenue Lift Bridge is its General Electric amplidyne-controlled drive system. Working closely with Woodruff & Sampson, consulting engineers for the Corps of Engineers, Judson Pacific–Murphy Corp., general contractors, and Enterprise Electric Works, electrical contractors, G.E. has again engineered the versatile amplidyne into an outstanding movable-bridge system.

This is but one example of the help G-E engineers can provide *your* engineers or consultants on installed equipment for heavy construction projects. Contact your G-E Apparatus Sales Office, General Electric Company, Schenectady 5, N. Y. 664-23

WORLD'S FIRST amplidyne-controlled lift bridge pioneered by G.E. is Stickel Memorial Bridge in New Jersey. Consulting engineers were Hardesty & Hanover.

Engineered Electrical Systems For Heavy Construction

GENERAL ELECTRIC

HIGHWAY BRIDGES
SCHOOLS & PUBLIC BUILDINGS
INDUSTRIAL BUILDINGS
ALLIED STRUCTURAL STEEL COMPANIES
Engineers • Fabricators • Erectors
20 NORTH WACKER DRIVE, CHICAGO 6, ILLINOIS

where ALLIED *fits in your picture*

When plans and specifications are completed for structures calling for structural steel, Allied is equipped to fabricate it. Three large shops with identical equipment are prepared to show you new speed in fabricating the steel and delivering it on location. Erecting crews know the short-cuts to get the structure up fast.

If your plans are in the talking stage, you are invited to consult with our engineers.

- Clinton Bridge Corporation
- Gage Structural Steel Corporation
- Midland Structural Steel Corporation

Fabricators and erectors of structural steel for highway and railroad bridges; industrial, office, school, and government buildings; Airport structures; Harbor facilities.

Send your master mechanic to check on the new

GARDNER-DENVER

600

COMPARE

these Gardner-Denver values . . .
no other 600-foot portable has them all

A real 600 — that's truly designed for 600-foot capacity.

Stamina — to run more hours per year for more years — to clock more hours between overhauls.

The right weight — for those long, tough jobs that demand durability.

Two-stage — gives high output for any work.

Fully water-cooled — for all-weather operation — has no complicated oil and water separation problem.

Easy starting — through use of a heavy-duty clutch.

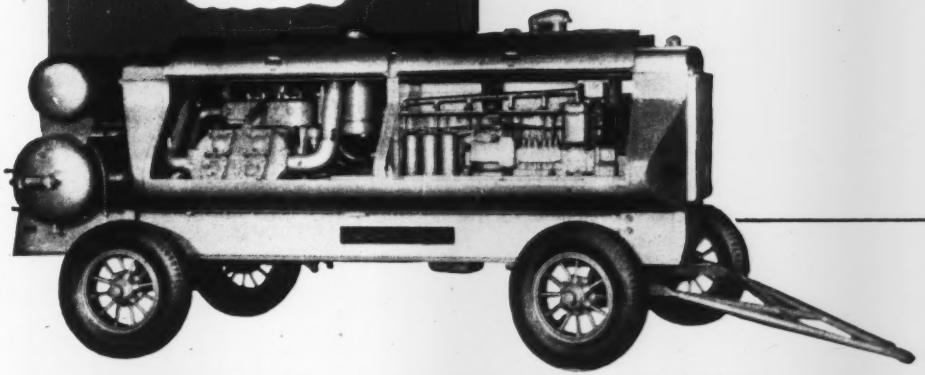
Simple controls — easy to understand — easy to use.

Moderate operating speeds — mean less wear and vibration.

Operates on sloping ground — as well as on the level.

Saves repair time — any master mechanic can make repairs in the field, with ordinary tools.

And don't forget — to compare fuel consumption, too.



Get GARDNER-DENVER and you get MORE VALUE FOR YOUR MONEY

Ask for complete specifications on the Gardner-Denver 600—the big capacity portable air compressor that's built for the discriminating buyer—and backed by Gardner-Denver's 93 years of quality manufacturing experience.

SINCE 1859 GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd., Toronto, Ontario

Minimize **PITTING**

Eliminate **PATCHING**

Insist on **GLOBE FORM GREASE**

The Wonder Grease for Concrete Forms

REGARDLESS of whether you use steel or wooden forms for concrete work — you can apply Globe Form Grease by spray, brush, or swab. This time-tested paste emulsion will reduce peeling and pitting to a minimum when forms are removed, and practically eliminate patching.

Due to its special adhering qualities, Globe Form Grease requires only a thin coating for utmost effectiveness. In fact, one gallon adequately covers approximately 200 square feet! And in addition — Globe Form is stainless, leaves a whiter smoother surface, and eliminates the need for painting.

Why not write for full particulars today? Once you use Globe Form Grease, you'll understand why engineers and contractors hail it as the "wonder grease" for concrete forms.

OILS *and* GREASES
for every purpose
DIESEL
STEAM
AUTOMOTIVE

Write for descriptive booklet of all Borne, Scrymser products.

BORNE SCRYMSER Since 1874

Our Laboratory Facilities are always at your disposal

BORNE, SCRYMSER COMPANY ELIZABETH, N. J. • CHARLOTTE, N. C.

How Much Do You Think it Costs to Map a 140-Mile Turnpike?

☐ $278,000 ☐ $83,000 ☐ $415,000

The right answer, of course, depends on how the mapping is done. The record shows the right answer for most large scale projects is economical AERO mapping. You can save time and money with dependable AERO surveys, whether your project is a turnpike . . . locating pipe lines or power lines . . . planning a mining development or dam site location . . . selecting a railroad route . . . or planning for city growth or any big industrial expansion.

AERO, the pioneer and leader in aerial photo-mapping, has the experienced men and equipment to do a job for you. Call in AERO engineers at the planning stage of your next large project.

Which figure did you check?

☐ $83,000 for Aero Service map-ping for a 1-mile wide route strip, with 5 ft. contours, done in 115 days. Pennsylvania Turn-pike engineers said ground sur-veys would have cost $415,000 and taken 2½ years.

"All preliminary line and grade studies, interchange layouts, grade separation studies, quanti-ty estimates and cost esti-mates were based on these topo-graphic maps," say the Turn-pike designers. *Ask us for Frank J. Williams' important Civil Engineering report on this work.*

AERO
SERVICE CORPORATION
PHILADELPHIA 20, PENNSYLVANIA
Oldest Flying Corporation in the World

In Canada, our affiliate is CANADIAN AERO SERVICE, LTD., *Ottawa*

Get More Production *out of* WATER POWER

WHY put up with inefficient equipment, that gives only mediocre performance, when you can improve power efficiency by modernizing your present plant? Why continue to let obsolete, or poorly functioning machinery cut down your production and eat into your profits?

Take, for example, a City which recently installed a new Smith-Kaplan Turbine. This unit replaced *two* old-style turbines, retired a Diesel Station to standby service, and brought about expansion of local industries, resulting from increased electric current available at low cost.

Why not enjoy such benefits?

The present demands the utmost of industry. Avail yourself of our experience, and the help of our technical staff, in working out the *solution to your problem!*

If It's Hydraulics-Put It Up To Us

S. MORGAN SMITH COMPANY
YORK, PENNSYLVANIA, U.S.A.

POWER *by* SMITH

ZONED EQUIPMENT:

Modern as the jet field it builds

Jet planes need elbow room. Wherever swept back jets hustle into the sky or thunder home to roost, they need plenty of open space. A few miles south of Youngstown, the Air Force has flattened and reshuffled many Ohio acres to give the jets the room they need.

To pave the way for the streaking planes, Allegheny Asphalt & Paving Co., Pittsburgh, excavated 1,500,000 yards, embanking 821,000 yards and relocating 1½ miles of roads. For the jets, this will mean 5,000 more feet of runway, 5,000 extra feet of taxiway.

For the high-speed jets the company used high-speed methods. It employed a fleet of 34 "Caterpillar" Diesel Tractors, four No. 112 Motor Graders, Scrapers, Dozers, sheepsfoot tampers and other auxiliary equipment. Why "Caterpillar" products? Because they're designed and built for economical, zoned earthmoving.

Three zones. A big job needs standardized equipment designed for the three principal construction zones. "Caterpillar" offers a line created for this progressive method of construction.

For high speed, long hauls on good haul roads, Allegheny utilized its four DW21 wheel-type Tractors with No. 21 Scrapers and some of its 27 D8 Tractors for push loading.

For the shorter distances and rougher ground of the middle-speed zone, the D8s were hitched to scrapers.

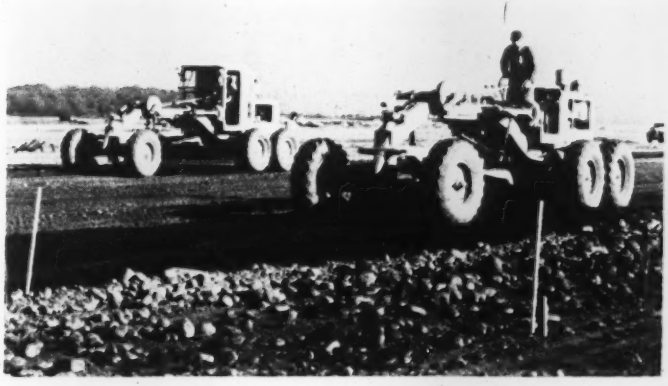
And for the short, rough, important power zone, it had available the D4, D6, D7 and D8 Tractors with Dozers.

Helping in all three zones were the four talented No. 112 Motor Graders, maintaining haul roads, ditching, banking and filling. Constantly at work . . . constantly useful.

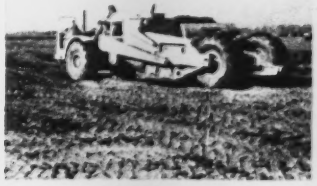
A fleet of powerful big yellow machines roared over the ground leaving in their wake a Herculean job of earthmoving. Now graceful jets flash into the sky leaving a wispy vapor trail scribbled in the heavens.

Power zone operations by D8s. Foreground, powerful D8 is spreading while in the background a D8 is pulling a sheepsfoot tamper.

Middle speed zone operations by D8 and No. 21 Scraper. This unit works quickly and smoothly for shorter haul distances and rougher ground.



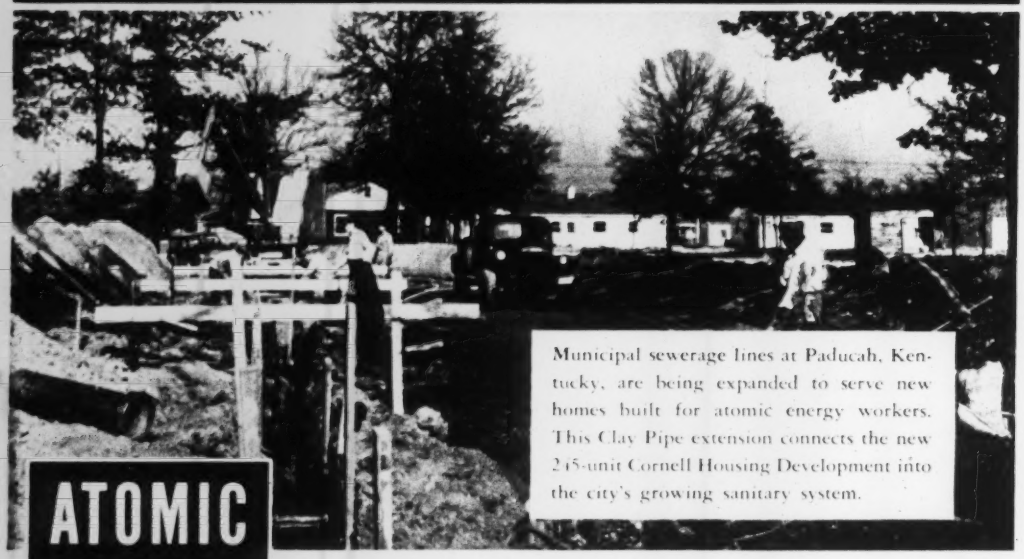
Versatile No. 112 Motor Graders are helpmates for other "Caterpillar" equipment in all three zones. Here they are spreading on runways.



High-speed zone operations by a big yellow D8 with No. 21 Scraper. High speed and big capacity of this unit equip it for this zone.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

CLAY PIPE—ESSENTIAL • ECONOMICAL • EVERLASTING



Municipal sewerage lines at Paducah, Kentucky, are being expanded to serve new homes built for atomic energy workers. This Clay Pipe extension connects the new 215-unit Cornell Housing Development into the city's growing sanitary system.

ATOMIC CENTER

EXPANDS CLAY PIPE SEWERAGE FACILITIES

Once-peaceful Paducah, now swarming under an influx of atomic energy workers which is expected to double the city's population, is meeting its new sanitary sewerage needs with Vitrified Clay Pipe.

Thousands of feet of Clay Pipe are being installed in one of the largest expansion programs ever undertaken in the state of Kentucky. Plans call for a total expenditure of $2.5 million.

In Paducah, as in leading defense centers the country over, readily-available Clay Pipe is going into the ground at a record rate. It's the one pipe that can be depended on for unfailing service—year after year, decade after decade. Chemically-inert clay can't be affected by acids or corrosive fluids. Its protection is permanent. *It never wears out!*

NATIONAL CLAY PIPE MANUFACTURERS, INC.
311 High Long Bldg., 5 East Long St., Columbus 15, Ohio
100 North LaSalle St., Room 2100, Chicago 2, Ill.
703 Ninth & Hill Bldg., Los Angeles 15, Calif.
206 Connally Building, Atlanta 3, Georgia

Wherever Reliable, Performance-Proved Pipe Is Needed, Specifications Call for Vitrified Clay

Panama City, Fla. (Municipal Expansion)	450,000 ft.
Bakersfield, Calif. (Municipal Expansion)	313,000 ft.
Limestone, Maine (Air Force Base)	65,000 ft.
Rapid City, S. D. (Air Force Base)	54,000 ft.
Orlando City, Fla. (Air Force Base)	74,000 ft.
Tucson, Ariz. (Air Force Base)	440,000 ft.
Morrisville, Pa. (New Steel Defense Plant)	300,000 ft.
Rantoul, Ill. (Chanute Field)	158,000 ft.

Vitrified CLAY PIPE — CLAY PIPE NEVER WEARS OUT

C-152-4

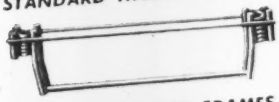
For Dependable Concrete Forming...

USE SUPERIOR CONCRETE ACCESSORIES

SNAP TIES

STANDARD HANGER FRAMES

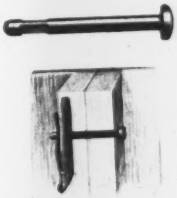
STANDARD COIL TIES



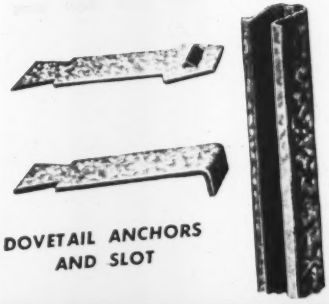
SPECIAL HANGER FRAMES

CONE-FAST COIL TIES

ROD CLAMPS



PANEL LOCK BOLTS



DOVETAIL ANCHORS AND SLOT

ADJUSTABLE SCREED CHAIRS

Here you see several of the many various types of Form Ties, Anchors and other concrete accessories which SUPERIOR'S many years of know-how and dependability have produced to meet rigid job specifications.

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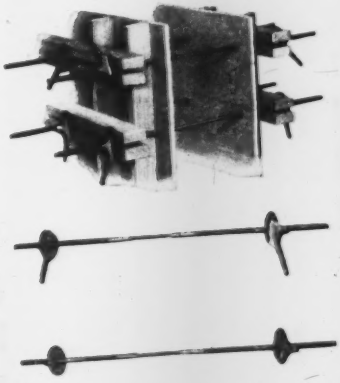

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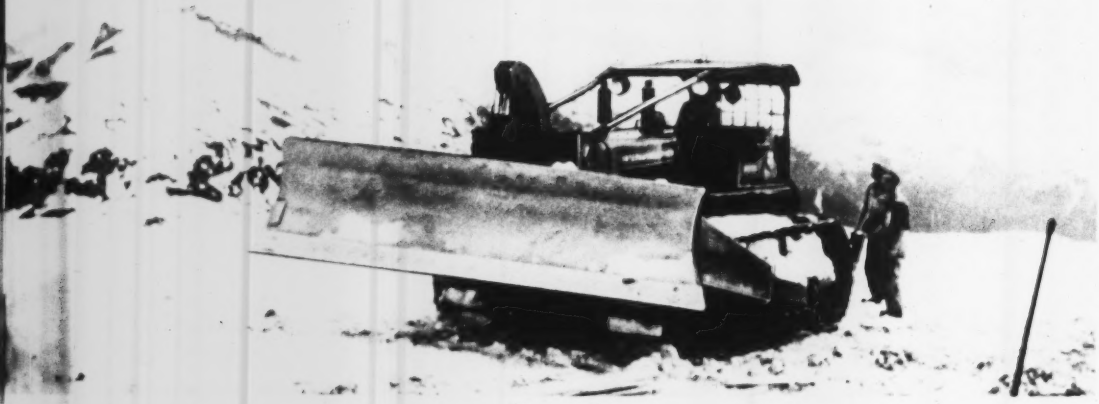

1 **RAISING KENNEY DAM** to fill the Grand Canyon of the Nechako River, workers sluice down some of the 3.8 million cubic yards of earth and rock it will eventually contain. Dam will form a reservoir with twice the capacity of Grand Coulee. TD-24 in foreground strips blasted rock from canyon wall abutment.

2 **HEADING OPERATIONS** at Kenney Dam are (left to right) Alcan Resident Engineer Harry "Jonnie" General Superintendent "Hak" Nielsen and Project Manager Jack Brenner, both of Mannix, Ltd., sub-contractor for Morrison Knudsen Company of Canada, Ltd.

110 miles west, dammed up waters will be diverted through mountains and dropped a half mile to run turbines in sea-level powerhouse.

3 **DRIVING TEN-MILE TUNNEL** through mountain is done from four headings. Here, half a mile above ocean-level valley, aerial tramway has delivered TD-24 to tunnel portal for working debris down mountain. 2,600 feet below, eight-story powerhouse inside mountain is being mucked out by a TD-24 and a TD-9.

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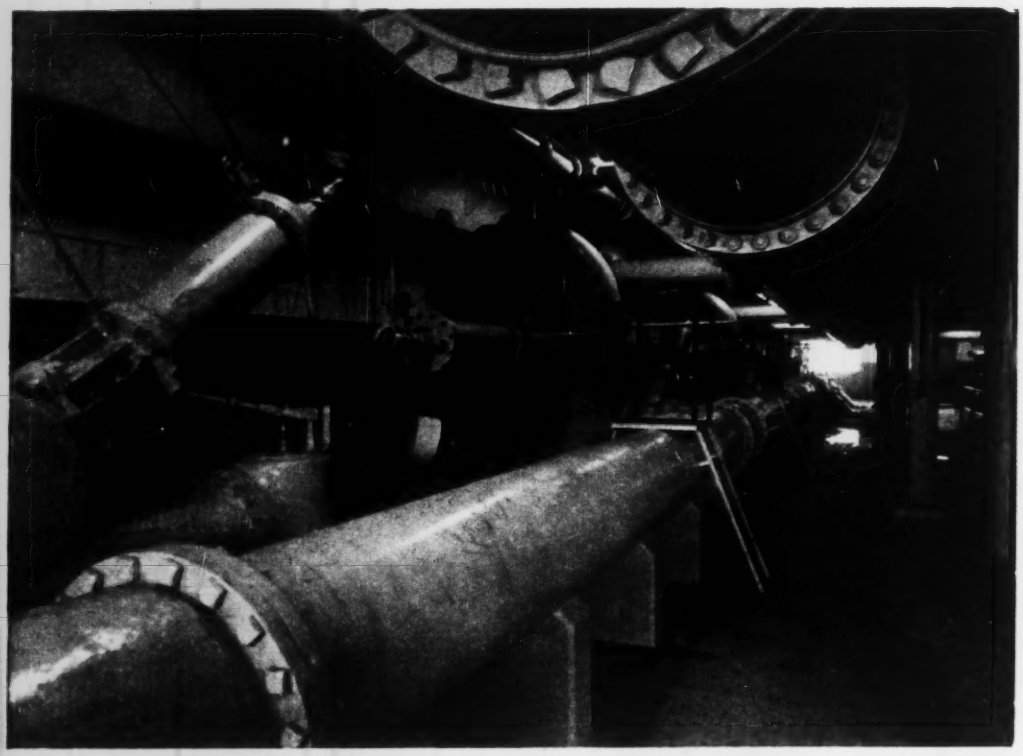
POWER THAT PAYS

4 **INSPECTING MOUNTAIN TOP OPERATIONS** at Kemano, headquarters for construction of powerhouse, tunnels and transmission line are (left to right) A. O. Strandberg, Project Manager for Morrison-Knudsen; F. T. Matthias, Alcan Assistant Project Manager, and Walter Abrahamson, Alcan Assistant Resident Engineer at Kemano.

5 **LINKING UP POWER TRANSMISSION LINE ROAD,** a pair of TD-24s doze toward each other through blasted rock. Across 50 miles of rugged terrain like this, a mountain-anchored powerline will be built to flash abundant electricity from mountain powerhouse to smelter at tidewater.

6 **NEW LAND IS MADE IN OCEAN INLET** by dredge which deepens anchorage for ocean shipping at the same time. H. M. Whiting (right), Project Manager for Kitimat Constructors, Ltd., and a superintendent study progress. Part of this 70 acres of new land will become site of new aluminum smelter. Town which may eventually become city of 50,000 will be built across the bay.



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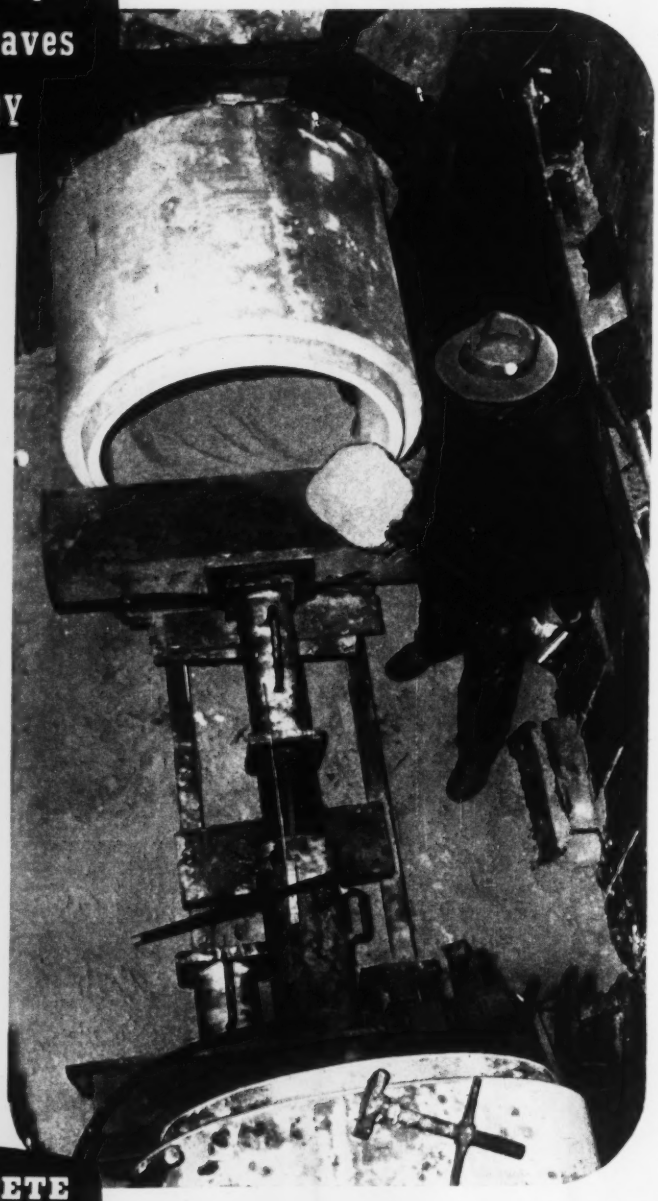

Jacking 36-inch concrete pipe under 14 lines of railroad track at Gary, Ind. The end of 50 feet of pipe jacked into position is shown in lower part of photo. This section is being used as backstop for jacking pipe in opposite direction.

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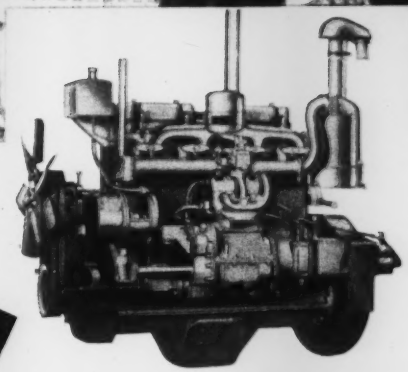

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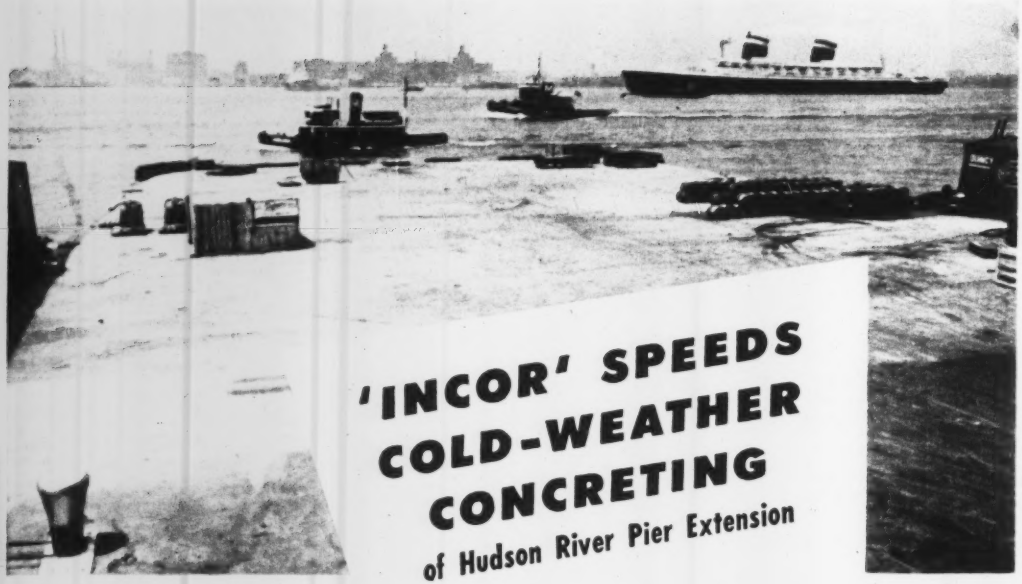

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CIVIL ENGINEERING

NOVEMBER 1952

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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No Need to go to the Water Hole . . .

In bygone days, man went to the water hole, spring, or well for drinking water. Washday was held on the river bank. For the most part, however, this is not true today. Modern fresh water systems, in city and rural areas alike, bring the water to you. It's there when you need it—just turn the tap.

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Waterspheres are built in standard capacities from 25,000 to 250,000 gallons. Other Horton elevated tanks with ellipsoidal-bottoms are available in standard capacities from 15,000 to 500,000 gallons—with radial-cone bottoms from 500,000 to 3,000,000 gallons. For further information, please write our nearest office.

Illustrated above is a 150,000-gallon Horton Watersphere erected for the Harris County Fresh Water Supply District No. 2 at Webster, near Baytown, Texas. This tank has increased water pressure 20 lbs. per sq. in. in Webster's distribution system.

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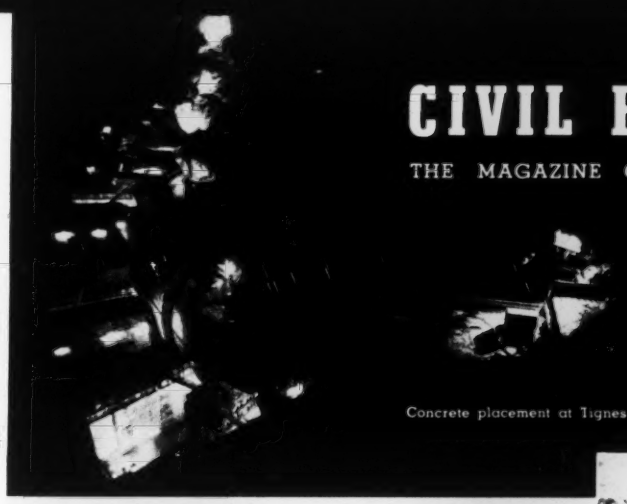


Concrete placement at Tignes Dam goes on around the clock, in three 8-hour shifts.

Tignes Dam in French Alps constructed with American equipment

PAUL A. MONTAGNÉ, A.M. ASCE
Field Engineer, L'Enterprise Industrielle, Les Brevieres, Savoie, France

Tignes Dam, in narrow gorge of Isère River, is shown here at end of 1951 construction season. Dam has just been completed—end of 1952 construction season.

FIG. 1.

Now that the Tignes Dam has been completed on schedule, at the end of its third concreting season, the construction story of this French postwar dam, built by the use of a modern, simple, large and highly mechanized plant, can be told.

Tignes Dam is a unit of the 140-million-dollar Haute Isère Project of Électricité de France on the Isère River, a tributary of the Rhone River, located in the northeastern part of the French Alps near the Italian border. The general location and extent of the project are shown in Figs. 1 and 2. The construction contract for 60 million dollars was awarded to L'Enterprise Industrielle as general contractor.

This thin-arch concrete structure, designed by André Coyne, Hon. M. ASCE, president of the International Commission on Large Dams, has a maximum height of about 590 ft above bedrock, a thickness of 140 ft at the base, and a crest length of 980 ft. It required about 825,000 cu yd of concrete (Fig. 3).

Because the dam is above El. 6,000, the working season was normally less than 150 days a year. France needs the power from this proj-

cet by the beginning of 1961, and because the largest part of the construction equipment was not available before late 1949, it was vital to build the dam as rapidly as possible, making maximum use of the mechanized equipment obtained to erect the high level concrete plant.

The general layout for the construction plant was designed by Henry Gautier, head of the contractor's designing staff. The principal items of equipment, in the sequence of their use from the quarry to the concrete in place, are described in the following paragraphs. The layout for the construction plant is shown in Fig. 1.

Equipment used at the quarry included two 29-T Bucyrus well drills which bored 9-in. holes; two P- and H-3 cu yd diesel shovels; two Bucyrus 1-cu yd diesel shovels; two Caterpillar D8 angledozers; ten Euclid 12-cu yd rear dumpers; and a 42-in. Allis-Chalmers "primary" crusher. From the quarry to the secondary crushing plant, the rock was carried by two Saar Hecker cable tramways, each 1.25 miles long, with a capacity of 700 tons per hour.

The equipment in the secondary screening and crushing plant was a French Stein Dragon two-line installation, each line with a capacity of 700 tons per hour. The aggregate processing plant was a French Stein Boyer installation which provided five different sizes up to 10 in. and included storage facilities for 20,000 tons. The crushed limestone aggregates flowed from the primary crusher to the mixing plant through two identical lines of machines and belt conveyors. This arrangement greatly stabilized and improved the daily output.

Cement was kept near the stored aggregate in six silos of 500-ton capacity each, supplied by a French Monzies single-cable tramway of 30-ton per-hour capacity and 1.5 miles long, running from the railroad station at Bourg St. Maurice. From the silos to the mixing plant, the cement was pumped by a Fuller pump with a capacity of 50 tons per hour.

The mixing plant consisted of a Johnson tower with four 3-cu yd Winget-Koering mixers, which had a maximum capacity of 240 cu yd of concrete per hour. The high lines were three Lidgerwood cableways, one of 10-ton and two of 20-ton capacity, with a single fixed tail tower and three moving head towers. The 10-ton cableway, used only for moving equipment and materials, had the highest head tower, which permitted it to travel over and across the two 20-ton cableways. The distance between the tail tower and the 10-ton head tower was about 2,000 ft.

All these installations, which contained 6,000 tons of structural steel, were supplied and erected after November 1, 1949. The most difficult construction was completed during the ensuing winter, when the temperature was sometimes −5 deg F, and the roads were frozen.

The first concrete batch was mixed on August 2, 1950, but because of many problems encountered in setting up the high level plant, only 66,000 cu yd of concrete was placed during the 1950 working season. In the same working season a small low level concrete plant, built in the canyon by utilizing some prewar French equipment, placed 46,000 cu yd of concrete. This low level plant, designed for an output of 460 cu yd per day, was originally planned for use during the first three months of the 1950 working season, while the high level plant was being erected.

On November 1, 1950, concreting was about two months behind schedule. For one reason, we had worked two shifts of 9 hours each between 4.5 a.m. and 10 p.m., with light maintenance between the shifts and heavier maintenance at night and on Sundays. This schedule required too much overtime pay, and it was difficult to get the work started promptly in the early morning.

During the 1951 season, for the first time in France on this kind of construction, work went on around the clock, in three shifts of 8 hours each. Light maintenance work was done during the day by special crews of highly skilled workmen, and heavy maintenance on Sundays, with two of the normal shifts and special maintenance crews. After 141 days of work, 400,000 cu yd of concrete had been placed, and we were on schedule again. In 1951, concrete placing was started on April 23 and shut down on November 1. During this time there was a two-week strike for higher wages. The average daily output was about 2,850 cu yd; the maximum output of 4,850 cu yd being obtained on October 6. The best month was October, when 83,500 cu yd were placed in 25 working days.

The amount of concrete placed in the 1951 working season would have been even greater if we had had more cement. Cement had been ordered in sufficient quantity to produce 2,300 cu yd of concrete a day, 6 days a week, but twice we ran short. Almost the whole season we worked without enough cement in at-site storage to be independent of the daily supply brought in on the 15-mile one-cable tramway. The tramway had some mechanical trouble because it ran 24 hours a day, with only the light maintenance that was possible under such a schedule.

The 1952 working season started on April 23 and the mass of the concrete

FIG. 2. Haute Isère Project, of which Tignes Dam is one unit, will have 140,000-hp installed hydroelectric capacity for government-controlled Electricité de France.

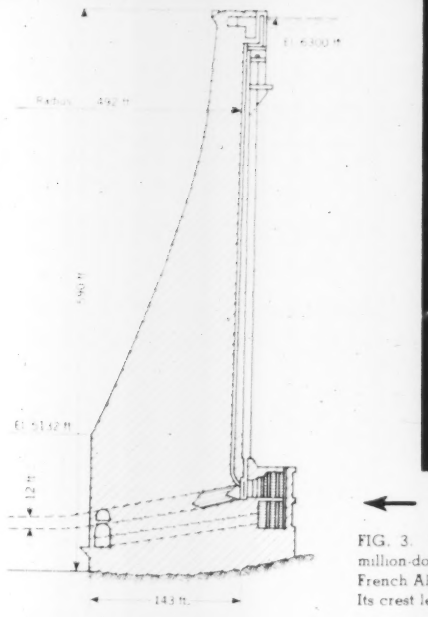


FIG. 3. Tignes Dam, storage unit of 140-million-dollar Haute Isère Project high in French Alps, is tallest dam in Europe, 590 ft. Its crest length is 980 ft.

Limestone aggregate, quarried and crushed 1½ miles upstream, is transported by double rope-cable tramway to high-level concrete mixing plant, at right of dam. See also Fig. 4. Cement is transported 15 miles from railhead by single rope-cable tramway.

for the dam was topped out October 20, with 330,000 cu yd of concrete placed in 140 days. On July 7 the maximum output of 1951 was surpassed with 6,044 cu yd placed in 24 hours with two 20-ton cableways.

Specifications for the mass concrete in Tignes Dam were as follows:

Material	Quantity by Weight
Sand: up to 0.12 in.	17%
Coarse aggregate: 0.6 to 2 in.	33%
Boulders: 4.8 to 10 in.	50%
Cement: per cu yd	4 sacks
Water-cement ratio	0.70

This concrete, designed to save cement, and hence money, can be classified as a "sensitive" mix, and it is my belief that it did not accomplish its purpose. It required too much work for proper placing, and often more cement had to be added to offset the sand and water added to facilitate placing.

The concrete was sensitive because of the large size of the boulders and the gap grading. Also the water-cement ratio seemed too low for the quantity of cement and the kind of rock used.

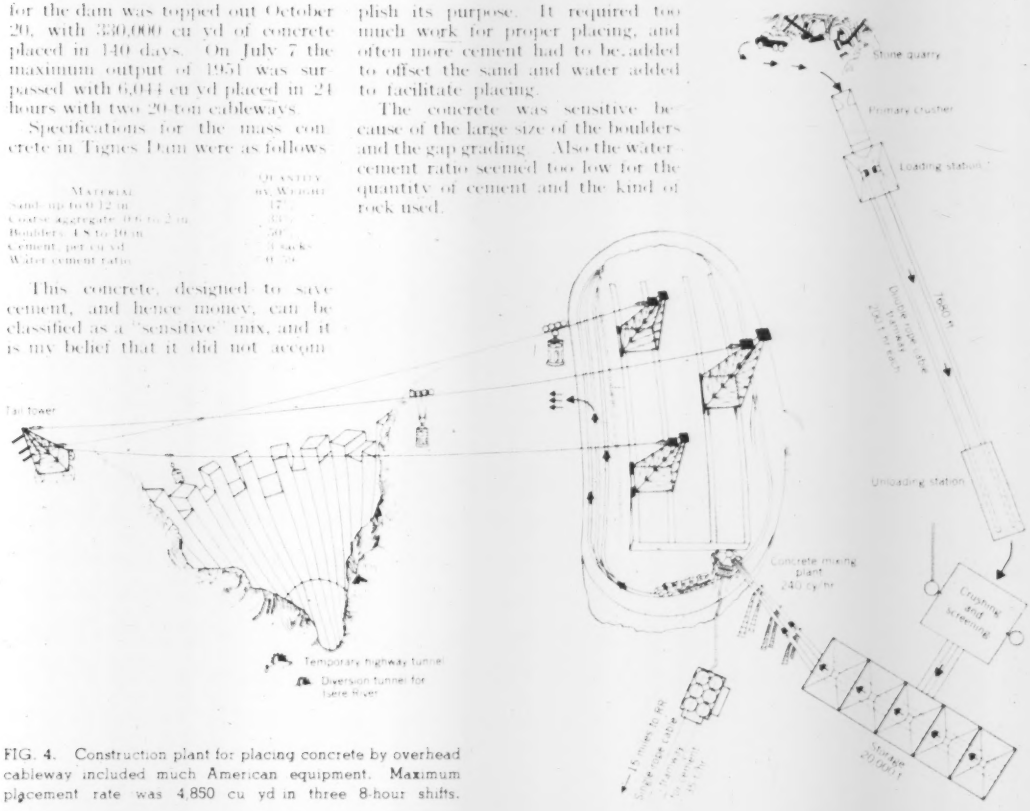


FIG. 4. Construction plant for placing concrete by overhead cableway included much American equipment. Maximum placement rate was 4,850 cu yd in three 8-hour shifts.

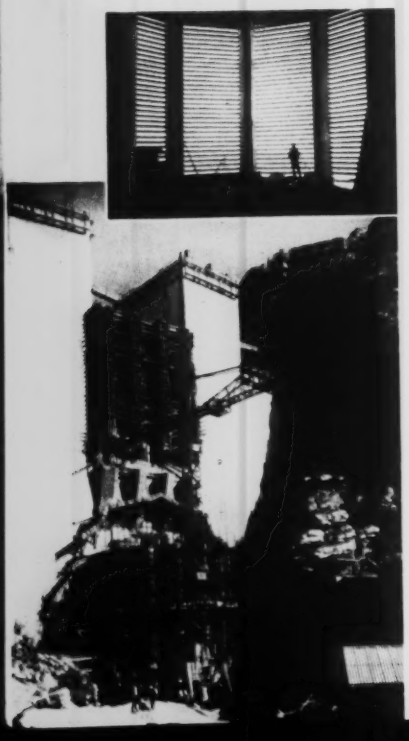
The aggregates were all crushed limestone which, when blasted and crushed, produces a lot of dust. This dust can be taken off by several types of cleaners. Sturtevant and Rotoclone were used on this project in the secondary crushing plant or at the entrance to the stock pile. But when the rock is wet, which often happened, the cleaners do not work well and a large amount of dust is deposited in cones in the stock pile sometimes amounting to as much as 20 percent of the weight of the sand. When this dust got into the concrete, the air entraining agent Darex did not work well, the concrete became harsh and unworkable, and needed more water. So more cement was required because the water cement ratio had to be kept constant to meet the specifications. On the job the point where more water (and cement) had to be added was reached when the two man electric vibrators ceased to be able to place the concrete. Normally, with the average workable concrete, two vibrators can place an 8 cu yd bucket in 2.5 min.

Large size aggregate (10 in. maximum) often produced harsh concrete difficult to vibrate into place.

The gap grading and the size of the boulders made the situation more critical because a small change in the grading of each size of aggregate was bound to occur, decreasing the workability still further. The only solution was to add more sand and water, and hence more cement.

Another difficulty was that the normal output of the crushing plants did not conform with the specified requirements of the gap grading, but produced too many 2.5 in. aggregate. To use this excess 2.5 in. aggregate, a second mix was designed in which more cement (6.75 sacks per cu yd) was used than in the mass concrete. This mix was batched one third of the time. During the 1951 construction season the richer mix was used for the facing concrete placed on the outer 10 ft of the upstream and downstream faces.

Outlet works were constructed during 1951 working season by low level concrete plant.



The 10 in. boulders, 50 percent by weight for each batch, were hard to handle. In the winter of 1950-1951 we had to change all the equipment for handling this size of aggregate through the Johnson tower by providing special new chutes, a new Zublin extractor at the bottom of the tower storage silo, a new heavy duty scale, and a new and stronger rotating hopper above the concrete mixers, which also were reinforced. In spite of these changes and reinforcements, the boulders punished the equipment through which they passed in the 24 hours of work every day, so that on Sundays a tremendous amount of maintenance had to be done, especially in changing the reinforcing steel wearing plates.

As a result of all these expenses — changes in plant, wear of mechanical parts, and increased use of cement due to the just average workability of such a sensitive concrete — no money was saved by using the 10 in. aggregate and some may have been wasted. If a 6 in. maximum sized aggregate had been used, it would have been possible to use a leaner concrete, more easily worked at a water cement ratio of about 0.50. It is believed that a considerable saving would have been realized with this aggregate, with fewer cracks in the finished concrete and less rise in temperature during the setting period. Also, more of the product of the crushing plants could have been used economically.

The concrete we worked with did, however, give good results after placing. For instance, 12 × 24 in. cylinder samples gave a compressive strength of about 2,400 lb per sq in. at 7 days.

What About the Men?

Since we used American made equipment almost entirely, we had to use American methods of work. During 1950 we tried to give responsible jobs to the older people in the company, but in 1951 our policy was changed to put younger men in at all steps of the production chain because they had no deep seated habits developed by working with older, prewar, and smaller equipment. This was one of the reasons for the good progress made during the 1951 working season. With some experience behind them, these young people did an even better job in the 1952 working season.

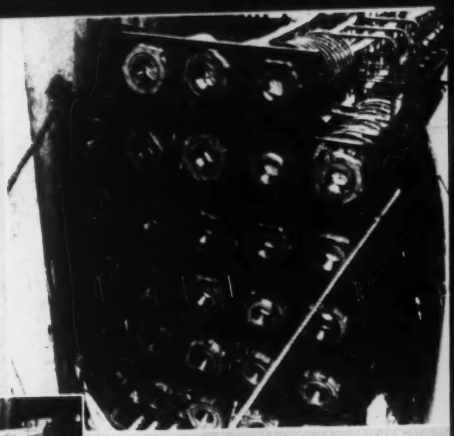
As the dam became thinner, progress was more difficult. After two months of good output, the pours became too small to allow three work shifts. In effect, the dam was divided into 24 monoliths, and the specifications allowed concrete to be placed in 5 ft lifts every 72 hours.

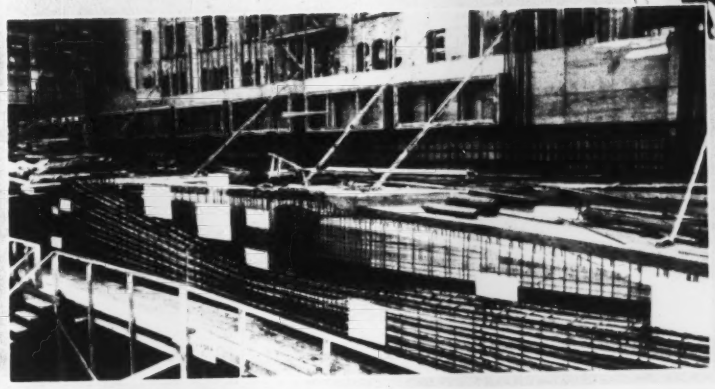
Because of the remoteness of the site, in the mountainous area of the French Alps, complete living facilities were provided for the workmen in the Tignes Valley above the dam. Preparations begun in 1947 required construction during three working seasons. The facilities included dormitories providing 2,500 beds, 250 camp houses, four first aid stations, eight canteens, 2,200 sq ft of shops, and 5,000 sq ft of warehouse and storage space. During this period 5 miles of temporary roads and 8 miles of permanent road relocation were completed. Another three years were spent in constructing the concrete plant and placing the concrete the working seasons of 1950, 1951, and 1952.

Storage of water behind the dam began in March of 1952. The ancient village of Tignes, in the reservoir area, had been reconstructed above reservoir level.

Big loads—no steel

result in record prestressed parking girders





In downtown San Francisco construction is now under way on a garage building containing girders which are believed to be the heaviest prestressed concrete building girders in the world. They also are the heaviest prestressed concrete girders in the United States, including bridge girders. (See Fig. 1.)

The Barrett Lick Garage consists of three stories and a basement, with provision for the addition of three more stories, to bring the total parking capacity to more than 800 cars.

The heavy continuous prestressed girders support at mid span columns carrying the parking floors. One of the largest of these girders is 4 ft 0 in. × 7 ft 8 in. deep, with a T flange 8 ft 0 in. wide. On a 62 ft 0 in. span, it carries a total load of 1,430 kips, of which 940 kips are concentrated near the mid span. It is prestressed with 28 strands of 1⅜ in. high-tensile cable, producing a total compression of 4,760,000 lb.

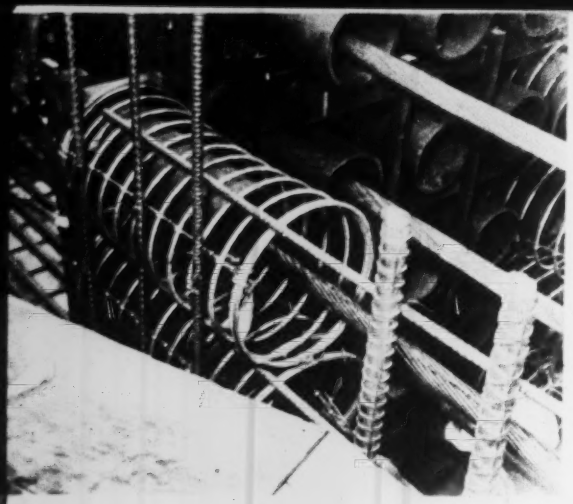
Several unusual features incorporated in the girders have resulted in considerable cost reduction. One feature integrates the girders with the floor slabs, thus utilizing the floor slabs as top flanges and obtaining maximum possible depths for the girders. Another feature postpones the tensioning of the girders until after the three upper floors in the present scheme have been poured. This makes it possible to carry the dead loads in the initial construction without compression in the top fibres, thus leaving the maximum moment capacity for any live or future loads. Furthermore, this postponement will allow the concrete to attain a higher strength at the time of prestressing.

Why Prestressed Girders

In order to provide an open marshaling space on the first floor, in the entrance area, three columns from the upper stories terminate at the second floor level and are carried by the prestressed girders spanning distances of 51 to 62 ft (Fig. 2). Because of the irregular shape of the site and the location of the center circular ramp, columns are staggered in alignment on the northern and southern halves of the building. Hence two of the column carrying girders, A and B, are supported by two continuous girders, E and F, at the northern ends. For construction as well as economic reasons, these two supporting girders are made continuous over their adjoining ends.

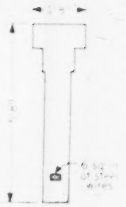
Because of the heavy loads on these girders, a steel design was naturally considered first. However, when construction started on the building in August 1951, civilian use of steel had already been seriously limited, and permission for its use on this project was denied by the NPA. The next material to be considered was reinforced concrete, but preliminary calculations produced members of such dimensions and cost as to make their use prohibitive. Ability to maintain an adequate headroom without recourse to increased story height, together with savings in cost and critical materials, were the factors that made the decision to use prestressed concrete for the building girders inescapable.

It was realized that an entirely distinct structural design would be required for each girder, and that special instruction and supervision would be needed for the field crews, which would add to the cost. However, the owner-contractor believed that the experience gained on this new type of construction would be a liberal education in itself, so that the extra supervision and planning would not need to be charged entirely to this job.



Pipe sleeves welded to heavy plates transmit part of prestress to concrete by bond. Spirals around outer row of pipe sleeves provide protection against spalling.

FIG. 1. Large size of Barrett-Lick Garage girders is clearly seen in this comparison with other heavy prestressed girders in United States. The Barrett-Lick girders are heaviest in United States and are believed to be heaviest building girders in world.



Arroyo Seco Bridge
Los Angeles, 1951

An approximate cost analysis, given in Table I, indicated a saving of about 20 percent over the original structural steel design.

Roebling Strands Adopted

The prestressing force of 1,760,000 lb for each of the heavier girders required 3.5 sq in. of wire at a stress of 130,000 psi. This meant 740 wires of 0.250 in. diameter or 1,270 wires of 0.192 in. diameter. To facilitate handling it was deemed desirable to use fabricated cables of relatively large size. After preliminary study, 1 in. Roebling strands and fittings were adopted for the entire job. The maximum number of strands per girder was only 28, and the work of arranging and placing the strands was much simplified.

Each 1 in. Roebling strand is made up of 37 wires, 12 of which are 0.092 in. in diameter, and the remainder vary in size between 0.100 and 0.192 in. for nesting. The strand has a cross-sectional area of 1.36 sq in., a minimum guaranteed ultimate strength of 270,000 lb (205,000 psi) and an allowable initial tensioning load of 170,000 lb (125,000 psi). Each strand was pretensioned in the factory to a value well above the proportional limit of the wires and held at that tension for a sufficient period of time to allow for readjustment.

Grouting is not mandatory for these strands since they are fabricated from hot dip galvanized wires and are greased and wrapped to prevent bond. It was realized that bonded wires would give a slightly greater factor of safety at ultimate strength, but the predominance of dead load on the girders and the improbability of any serious increase in load made the consideration of ultimate strength not too significant in this case. Hence all strands are unbonded. The entire prestressing operation was accomplished in six days, with a crew of four men working in two teams. Each team had two 60 ton jacks.

Three long girders (A, B, and C, Fig. 3) were designed as simple spans, each carrying a heavy concentrated load approximately at mid span, together with the additional uniform load along its length. For the design of the mid span section, two critical conditions were investigated.

The first critical condition occurred immediately after completion of the prestressing. At that stage the top fiber was under zero stress while the bottom fiber had a maximum compressive stress of 2,200 psi. This maximum compressive stress was gradually reduced as loss of prestress took place and also as additional dead and live loads were applied. The top fibers, although under zero stress immediately after prestressing, were under some compression as soon as loss of prestress took place.

For reasons of economy, the centroid of the cables was placed as low as possible in order to obtain a greater lever arm for the tensile force. This, however, produced a heavy eccentric moment which had to be counterbalanced by sufficient dead load on the girders at the time of prestressing. As previously mentioned, this was accomplished by postponing the application of prestress until after the three upper floors had been built.

The minimum compressive strength of the girder concrete was specified to be 5,500 psi at 28 days and 6,000 psi at the time of prestressing, which was expected to occur about two months after the placing of the concrete. A concrete mix of 8½ sacks of cement per cu yd with a water cement ratio of 0.58 was used, and 3.3 lb of pozzolith was added per cu yd, yielding a slump of about 4 in. The average tested cylinder strength at 28 days was 6,300 psi for the laboratory mix. Cylinders for the field mix attained an average strength of 5,300 psi at 28 days and of 6,300 psi at 49 days.

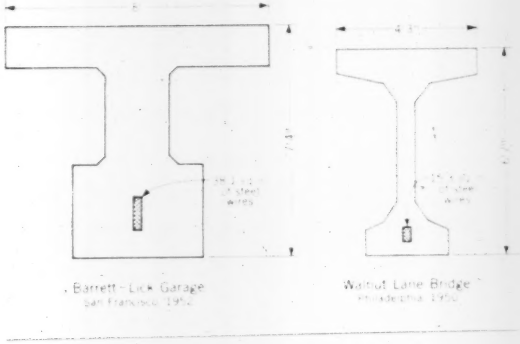
The second critical loading condition occurs when the future three stories are added and the full live load is on the structure. Figuring a loss of prestress of 16 percent, prestress in the cables would be reduced from 125,000 psi to 105,000 psi. Under such conditions the maximum compressive stress will occur at the top fibers and will have a maximum of only 1,800 psi or 0.33f'_c in terms of the 28 day strength.

The chosen I sections (Fig. 3) are economical for the simple spans, because most of the top flange is part of the floor slab and also because they give desirable stress distributions under both critical loading conditions.

Girder Ends and Anchorage

While the mid span section is designed primarily for bending, the end section is governed by bearing and anchorage requirements. According to most building codes, the allowable bearing on the full area of the concrete is only 0.25f'_c. This, if adopted for prestressed concrete anchorage, would necessitate a large bearing area and would complicate the design. However, in view of the fact that the cable stress increases only slightly for an increase in external load, a smaller apparent factor of safety is considered sufficient for anchorage bearing in prestressed concrete construction.

While an allowable bearing stress as high as 0.60f'_c has been used on other jobs of prestressed concrete, 0.45f'_c (2,500 psi) was adopted for



Barrett-Lick Garage
San Francisco, 1952

Walnut Lane Bridge
Philadelphia, 1950

During jacking operation two 60-ton jacks were mounted to tension the 1¼-in. cables. Some cables, which are already prestressed and anchored with their screw nuts, are shown at right.

this design. To insure additional safety, pipe sleeves welded to the end bearing plates were added to transmit part of the prestress into the concrete by bond between the sleeves and the concrete. Considering an allowable bond stress of $0.04f'_c$, the bearing on the concrete was further reduced to about $0.27f'_c$ (1,500 psi).

To insure the end concrete against possible spalling, spirals were provided around the end sleeves along each side of the girders. These spirals, of 11-in. inside diameter, are made of ⅜-in. A.S.T.M. A82-54 wires at 2¾-in. pitch. They are 1 ft 11 in. long and tack welded to the end bearing plates together with the necessary support bars. The holes in the end bearing plates were made slightly greater than the inside of the sleeves so that the end sockets of the anchorage system could be readily pulled through the bearing plates and brought to bear on the plates.

Other minor details are involved in the design of the end bearings (Fig. 4). For the simple span girders, the end socket is entirely within the 6-in. pipe at the jacking end before tensioning, and two ¾-in. keeper rods are provided to hold each socket in place. These rods pass through ⅞-in. holes provided in the sleeve, and the holes are filled with mastic as a seal against fresh concrete. Any slack in the cables is taken up on the nuts opposite the jacking end. To properly center the jacking equipment, four 1½×3½×6-in. centering lugs welded to the outside face of the bearing plates are provided for each strand at the jacking end. For the continuous girders, the sockets at both ends projected beyond the face of the end plates before tensioning was applied to the girders, and were held in place by the nuts.

As in most prestressed concrete girders, the diagonal tension is relatively low because of the high compressive stress set up in the concrete as a result of prestressing. In this case inclined strands carry part of the vertical shear and further reduce the diagonal tension. However, for the simple-span girders, the strands are almost horizontal at mid span where a heavy concentrated load is applied, hence the maximum shear on the concrete occurs near the mid-span, where full future loading will produce a vertical shearing stress of 330 psi. This, when combined with the compressive fiber stress, will result in a principal tensile stress of 106 psi at the centroidal axis and 123 psi at the junction of the web with the bottom flange. It is interesting to note that because of the lower compressive fiber stress below the centroidal axis, the greatest principal tensile stress does not occur at the centroidal axis where unit shearing stress is a maximum, but at some point below where the compressive fiber stress is relatively small.

Since the tensile stress of 123 psi is only about $0.02f'_c$, web reinforcement is not considered necessary. However, nominal stirrups are provided throughout the length of the girders in order to minimize local cracks. To position the strands in place, strand supports with welded hooks are provided at 5-ft intervals.

Concrete opposite the jacking end of each of the simple-span girders was poured integrally with the building. Complete separation at these ends would involve too much additional work in construction. Hence these unjacked ends are not simply supported, as assumed in the design, but are actually more or less fixed against rotation. Analysis indicates that the fixed-end moments induced both during prestressing and under future loads may be sufficient to produce cracks at these ends. Although such cracks would in no way endanger the safety of the structure, heavy reinforcing bars are placed at the ends in order to distribute the stress should cracks occur. Since the presence of these end bars may alter the moments and stresses in the girders, a check analysis was made to determine their possible effect, which was found to be within the allowable limits in all cases.

Most of the cables are bent up at mid span, where a concrete stiffener is provided to transmit the upward thrust thus produced. Because of the layout of the building, a few of the bottom cables are bent downward near the mid span, and the downward tensile pull thus produced is anchored by special stirrup bars.

Some longitudinal bars are also added along both the top and the bottom flanges at mid span in order to strengthen the bottom flange against high compression and the top flange against any possible tension in case of overloads.

Since only a relatively small amount of play is permitted in the end nuts of the strand anchorages, the positioning of the end bearing plates for the girders needed to be very accurate, and special rigs were designed to hold them. To avoid conflict in the placing of the strands and reinforcing bars, the order of installation was carefully scheduled.

Design of Continuous Spans

The two continuous spans, girders E and F (Fig. 3), could have been designed of ordinary reinforced concrete if it were not for the heavy shear in them. By using prestressed concrete, the principal tensile stress is

TABLE I. Cost Estimate for Prestressed Concrete Girders

FIG. 2. Plan and section show unusual column and girder layout. Irregularity of design was due to need for open marshaling area on first floor and to site shape.

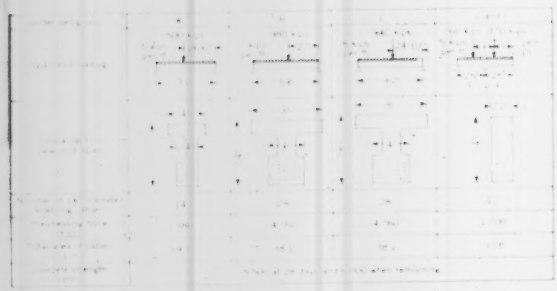


FIG. 3. Loading and girder data for five prestressed girders in Barrett-Lick Garage are shown above.

reduced from 417 psi to 221 psi. This tensile stress occurs below the centroidal axis of the girder and is about 6 percent higher than that at the centroidal axis. Double and single ⅜-in. U stirrups are provided as web reinforcement.

To carry the bending moment in the continuous girders eight ½-in. strands would be sufficient, but it would be difficult to arrange them so that they would be free of the intersecting strands from girders A and B, and to maintain the required minimum radius of bending of 12 ft. Hence 10 strands are used. These two spans are made continuous in order to save additional anchorages at the connecting ends, and also to produce a more desirable bending-moment diagram. One objection to this type of continuous construction is the possibility of loss of prestress in the cables due to friction as they bend around the reversed curves at the points of negative moment. To minimize such loss, tensioning for the cables was done by two jacks, one at each exterior end of the continuous girders. Furthermore, some cables were prestressed to 5 percent above the design prestress and then released in order to reduce frictional effects.

The cables were greased and wrapped with plastic tubing or two layers of sisalkraft paper to prevent bond with the concrete. The plastic tubes were furnished in 10-ft units, split and corrugated for their full length so that they could be easily wrapped around the strands. The tube is about 0.010 in. thick and permits an overlap of about ¾ in. along the split line.

Analysis brings forth the fact that continuous prestressed girders contain secondary moments induced by prestressing. These moments in this case amount to 25 percent of the primary moments, and provision for them was incorporated in the design.

Design for Strains

One of the unique problems encountered in prestressed concrete, especially in this building, is the

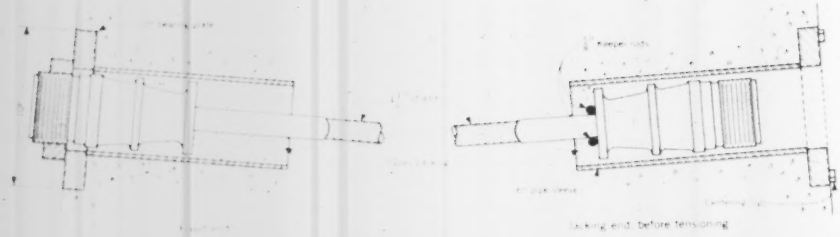


FIG. 4. End anchorages for simple span beams have socket at jacking end fully within pipe. For continuous guides, sockets projected beyond end plates at both ends before tensioning and were held in place by nuts.

stram induced by prestressing. To avoid dissipation of prestress and overstraining of adjoining members under prestressing, all the slabs and walls surrounding the girders were severed from the girders. Thus the girder concrete was poured as a distinct unit, separated almost completely from the rest of the building. The separating strips were doweled and concreted after prestressing.

Due consideration was given to the possibility of pouring the different portions at times and intervals that would ensure the harmonious shortening of the prestressed and ordinary concrete when tied together. However, it is believed that any possible cracking of the non prestressed floors at these points will not endanger their structural strength and hence no particular efforts were made to minimize such cracks.

Not only the adjoining slabs and walls but the connecting columns also were kept unattached to the prestressed girders. As the girders shortened under prestressing, enormous bending moments would have been forced upon the columns if they had been poured integrally with the girders. After several alternatives were considered, it was finally decided that all the columns would be severed from the girders. Different methods of isolating the columns were contemplated, but the method finally adopted was to provide two to four extra heavy 6-in. steel pipe columns for the temporary support of each connecting column. These pipe columns were erected out of plumb by $\frac{3}{16}$ to $\frac{3}{8}$ in. so that after the girders were shortened under prestressing, the pipes could be brought back into vertical position.

Temporary shoring for the girders carried a uniform load of 5 kips per ft and a concentrated load of 300 kips under each column. Four 12- × 12-in. timbers carried each concentration. Shoring was continued below the first floor slab to the basement.

The maximum upward deflection of each simple-span girder immediately after prestressing was about $\frac{1}{4}$ in. as expected. Full live load and future dead load will cause a downward deflection of $\frac{1}{2}$ in., resulting in a net downward deflection of only $\frac{1}{4}$ in. If steel girders had been used, total deflection due to dead load and live load would have been about 1 in.

The amount of tension in the strands was measured by jack gage pressure and accurately checked by the amount of elongation in the strands. For a modulus of elasticity of 25,000,000 psi for the strands, their elongation was about 4 in., while the elastic shortening of the girders was about $\frac{3}{16}$ in. Since the girders shortened gradually as the prestress was applied, those strands first stressed had a tendency to lose some of their initial stress. To obtain uniform tension in the strands, it was decided to stretch the first strands slightly more than those to be tensioned later. To avoid undue eccentricity during tensioning, the order of jacking followed a checkerboard pattern, starting in general from the center strands towards the top, bottom and sides. The continuous girders were tensioned first in order to furnish support for girders A and B; otherwise additional shoring would have been required at their junctions.

In order to record strains in the girder concrete, several Carlson strain gages were installed in one girder. Readings taken on these gages indicated a temperature of 150 deg F in the concrete the day after placing. No shrinkage cracks were noticeable at any time. Under prestressing, an average elastic shortening of 220 × 10^{-6} was recorded. It is hoped that the data obtained will add a little to our knowledge of the behavior of prestressed concrete, especially in heavy girders such as these.

Typical panel dimensions for the garage are 27 ft 6 in. × 25 ft 1 in., for which a conventional flat slab design would ordinarily be employed. A comparative design was made for a haunched slab supported directly on columns without any capital or drop. Since no existing specification or logical analysis can be directly applied to this unconventional design, model analysis by photo-reflective methods developed by the Presan Corporation of Los Angeles, Calif., was used.

To check the results of the model tests, elastic analysis was applied to the haunched slab. Additional analysis was made to determine the effect of skip loadings since tests on the model were performed only for full loading on all spans.

A comparison of the Presan slab as against the conventional flat slab showed a saving of 8 cents per sq ft for the former. The haunched slab produces a better architectural effect and leaves slightly more head room at the columns.

The garage is being built for Barrett Garages, Inc., by Barrett & Hilp, general contractors, with B. A. Stephenson as office engineer, G. McKeever as general superintendent, and S. Brown as job superintendent. The building was designed by Ellison & King, consulting structural engineers, San Francisco; and S. C. King, in collaboration with the writer, was responsible for the structural design. Unfortunately, Mr. King died just after the completion of the design. J. K. Rode supervised the construction for Ellison & King. Valuable advice was received from H. K. Preston, Jr., A.M. ASCE, and others of the John A. Roebling engineering staff, and from G. A. Bowen of the Presan Corporation.

Strands of continuous girder are humped over center support to take negative moment. Although strands were not bonded to concrete, continuous girders were jacked from both ends. As further insurance against friction loss, strands were overloaded and then slacked off to design tension.

A second century of service begins

President's Inaugural Address, October 15, 1952, New York

The American Society of Civil Engineers has completed the first century of its life and its record through this century, which has covered much of the development of modern engineering, is a proud one. No greater honor can come to any engineer than to be selected for this Society's presidency. I feel a deep sense of humility and a full consciousness of the task before me in being privileged to guide the Society in beginning the second century of its life.

Our task in engineering is to direct the sources of power in Nature to the use and convenience of man. This definition has applied throughout the ages. We start the second century with the same general task as that which faced our founding fathers but with very different conditions and necessarily with a different outlook.

When our Society was founded, the most pressing immediate problems before the nation related to expansion and development of sparsely settled areas, many of which had only so very recently been acquired. One of the greatest migrations of population ever known was in progress. Perhaps our people of that day might have been judged by some standards to have been "ill fed, ill clothed, and ill housed"; but they didn't think so and they were not dissatisfied. Above all they were self reliant. Conditions of the times nurtured this quality in the ordinary citizen and much more so in the engineer. Restriction and regimentation were little thought of and would not have been tolerated.

It is interesting to look backbriefly at the conditions of those days. Our population had pushed through the Alleghenies to the great areas of level and fertile lands of the Mississippi Basin. The California gold discovery was beckoning from still farther westward. Improved transportation was an imperative need. Extensive canals for transportation had been constructed, but their limitations were evident. The development of railroads had begun, but their great expansion was yet to come, and for many years this was the task to which a large percentage of our membership devoted its great est efforts. The lay world thought of a civil engineer as primarily a railroad builder.

For a proper appreciation of adverse public opinion which faced the early railroad builders, I have taken the following quotation from *The World Tomorrow*, as cited in an address by Robert Ridgeway, Past President ASCE, and Hon. M. ASCE (*Transactions*, ASCE, 1925, p. I, 256):

> " . . . the following resolution passed in 1828 by the School Board of Lancaster, Ohio, and once quoted by Dr. Eastlick: 'You are welcome to use the school house to debate all proper questions in. But such things as railroads and telegraphs are impossible, and rank infidelity. There is nothing in the word of God about them. If God had designed that his intelligent creatures should travel at the frightful speed of fifteen miles an hour by steam, He would have foretold it by the mouth of His holy prophets. It is a device of Satan to carry the souls of the faithful down to Hell.' "

Along with expansion of railways, rapid advances were made in the solution of other problems. New and better materials of construction were developed. Rapid strides were made in the art of design. Fundamental knowledge underlying the solution of problems in sanitation was acquired. Electricity was made a servant. The adaptation of steel to building construction, along with the development of elevators, made possible tall buildings and thus completely changed our cities. The perfecting of the combustion engine which in turn led to the development of the automobile has completely changed the whole pattern of modern transportation and, in fact, the way of life for our entire population. Finally, the development of aircraft made further radical changes in transportation, in city planning, and in other fields. Communication, including telegraph, telephone, radio, and television has kept pace. Great works for water supply, sanitation, flood control, irrigation, and power development have been constructed. The list could be expanded tremendously, but all this is only a beginning. It may be small, indeed, when compared with what will be accomplished in the century now starting. New discoveries and new inventions are certain. Some of the developments already visualized have potential power, which, if misdirected, could destroy civilization; but if properly directed, may revolutionize engineering progress. I shall take the optimistic view and hope for the latter.

The engineer's part in the past century of development is something of which we may be very proud. It is altogether proper that this part has been so clearly emphasized by the Centennial of Engineering in Chicago. However, we must not lose our opportunity to shape the present and thereby the future, by spending too much time contemplating the past century.

President Benjamin Ide Wheeler of the University of California, in his Commencement Address directed to my own class, well said:

> When a man has achieved something, it is better, not to stop for congratulations, but to move on. The achievement is to be treated as so much gathered headway and the moment of victory is the moment of opportunity. Stopping to look at one's self means loss of momentum, and in the race of life it is at any given time momentum more than distance that yields the reckoning. So in the things of the spirit it is tension and quality not weight and quantity that count. The leading runner in the dash dare not turn to watch his antagonist without periling the victory. Eyes were with purpose set in the front of heads, and they that make for the mountains must waste no time in gazing back toward the cities of the plain or measuring the way they have passed.

What can we do to give direction at the beginning of the second century of our Society's life? Certainly direction is needed. Never has there been more confusion of thought and purpose. "The world can never be lighted by purging out darkness, but only in the one old-fashioned way of letting the light shine in."

With the great developments of the past century has come a change in the pattern of thought of our people. Perhaps the engineer and his works have had much to do in bringing this about. Certainly the engineer has done most to change the surroundings and the way of life for all. Has he created a Frankenstein

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which he cannot control? I think not.

While these changes have been developing, the engineer has been slow to appraise the changed state of the thought of the nation. Accumulations of capital beyond those formerly vizualized are necessary for constructing the great works now required. Many of these accumulations are thought, often without reason, to be beyond the range of private capital, and so more and more has it become the habit to turn to the public purse—national, state, or local. Unfortunately much of the direction of public spending is done without due consideration of economic and engineering fundamentals. The engineer has, in too many instances, allowed the top command to fall to others who may have greater personal appeal to the masses, but who do not have the training, experience, or even the respect for sound economic or engineering analyses requisite for proper guidance. The engineer must assume the responsibility of furnishing and guiding public leadership to an extent which he has never done before.

Great engineering works are being designed, built, and operated by complicated governmental agencies on various levels—national, state, or local. The day of complete control of an engineering project by one mind is fast disappearing. While this situation may be inevitable to some extent, it is unfortunate. Responsibility goes only with authority. Wide division of authority leaves little responsibility at any level. A multitude of critics who have certain powers of review and approval has developed, but, since responsibility for the action of any single one is limited, the responsibility is often taken lightly. Economic studies and justifications for many projects often have not been subjected to sound engineering review. This condition is particularly true where the politician has entered with his theory of deriving prosperity by spending.

Many of the conditions confounding the engineering profession have resulted from failure to assume intelligent, forceful leadership. The tendency to shirk responsibility is too common at all levels—from the national down to the individual.

The future of our nation is in the hands of our young men, and this is a fact which is particularly true of the engineering profession. A special burden rests upon our educators. As in other phases of the profession, engineering education is beset with its own complexities and confusions. In spite of these difficulties I can see light ahead, largely because the problems are being recognized and are being brought out to sunlight for observation. The way may be long but progress is being made.

In this confused world it is easy to understand why the student, or even the young engineer, has great difficulty in charting his course and often stumbles. Unfortunately much of our present day literature is, in effect, slanted propaganda which even the mature mind must weigh carefully in order to ferret out the snares.

So many organizations, which have to do with engineering and related scientific fields, have sprung up that even the experienced engineer is at a loss to appreciate the fields and purposes of many of them. No wonder the novice is completely confused. Some times the rivalry approaches that described by Hardy Cross, Hon. M. ASCE, in his book, *Engineers and Ivory Towers*, McGraw Hill, 1952, wherein he refers to:

> the good lady who thanked God that, though her church had saved only two sinners during the year, the horrid old congregation down the street had not saved a single damned soul.

Ours is the oldest of all American engineering societies. The others of the Founder Societies have been formed to cover specialized fields. Fortunately, constructive cooperation with the other Founder Societies has been attained through the years and is increasing.

Great changes in our society have come about during the century of its life. I am sure the founding fathers did not envision its growth to some 35,000 members. The changes are not alone those due to growth in membership. For more than half its life the activities of the Society were very largely centered in New York City. That is not true today. The Society has become truly national. Today California is the state with the largest number of members. New York is second, Texas, third, and Pennsylvania, fourth. This change is due in large measure to the activities of Local Sections. Here is the direct contact of the Society with its membership. There are now some seventy three Local Sections. They vary widely, not only in size, but in organization, activity, and interests. It would not be possible to mold them to uniformity by any application of straight jackets supplied from overhead, nor would that be desirable. They should have certain guidance so that all will be working for common objectives leading to the betterment of our profession; but, so far as is compatible with the attainment of these objectives, they should be left to travel their own routes. Sections in sparsely settled areas where members travel considerable distances to meetings, naturally have different patterns from those of metropolitan areas where large concentrations of members are found within limited range. Some of our most effective Sections are in locations where effort is required for members to attend meetings and to carry on their work. For all of us the measure of our benefits from Society membership is proportional to the efforts we expend for the Society.

The engineer is accustomed to making predictions, but his methods are not adequate for peering far into the general situation facing us. His predictions ordinarily are based upon projecting hindsight a reasonable distance into the future. This method may afford a close approximation to such matters as the future demands upon a municipal water

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What construction means to America

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To answer adequately the question, "What does construction mean to America?" we must view construction in its three quite distinct aspects.

The first and most obvious of these aspects of construction is revealed in its product, the vast diversity of works and structures that it contributes to American life.

The second is its aspect as an industry in its own right, an aggregation of men, equipment, tools, and all the necessary operating paraphernalia assembled in effective organizations under competent management.

The third is its aspect as a dynamic factor in the national economy, exerting its influence on the cycle that affects and reflects the economic well being of the nation as a whole.

What construction means to America, then, is the combined effect of all these.

The Product of Construction

Considering the first of these three aspects, construction has been defined as the process by which man adapts his physical environment to his needs. Probably America is the preeminent example of this process in its most intensive form. Within the short span of four or five generations, half a continent has been transformed from a wilderness into a nation of 160 million people. Moreover, during this period, these people have created an environment in which they can enjoy a living standard unparalleled in history. In this country, less than 7 percent of the population of the world, living on 6 percent of the land area, produces nearly half of the world's income.

Here we are talking about a material standard of living, which is not to be confused with those intellectual and spiritual standards that may or may not accompany a high material standard of living. It is a capital mistake to assume, as we often do, that an abundance of material wealth will insure a high standard of human happiness or intellectual progress. But that is outside the scope of this discussion, and I mention it only to make clear that construction is primarily a servant of our *material* progress.

All the fixed physical plant and facilities that make possible our high living standards are the product of construction. The log cabins built by the pioneers, the wells that they dug and the trails that they hewed out of the forests were its first fruits. Over a century and a half, these primitive facilities have been so increased in variety, in size, and in cost that they now include all the amazing fixed plant of our industry, commerce and community life. They are embodied in our dwellings and business buildings, mines and factories, far-flung highway and railroad networks, dams, airports, tunnels, sanitary installations, irrigation and flood control facilities.

The Rise of the Specialist

This constant growth in the diversity and size of our structures has of necessity developed specialists in their design, construction and operation. These specialists have long since taken over the tasks once performed by the pioneers, each of whom provided his own facilities. One compelling reason for such specialization was the unceasing extension of our scientific frontiers. Out of it came the development of new materials, techniques, equipment, structures and other facilities required to render an ever higher degree of service and satisfaction.

Coupled with this scientific progress was the insatiable drive of the class free American to have more and enjoy more of the world's goods, his adventurous willingness to try new products and methods, his open-minded reception of the salesmen who pursued him in behalf of producers and merchants offering him something new or something better.

Above all, there beckoned always the geographical frontiers of a new nation, moving steadily westward as each successive surge revealed new challenges, new opportunities and new wealth for those who dared to face and grasp them.

Pioneers among these technical specialists were the civil engineer, the architect and the mining engineer. As requirements increased and mechanical power became available, more specialized help was provided by the mechanical and electrical engineers. And after them, came the chemical engineer, the automotive engineer, and a host of other ever more highly specialized technicians.

The civil engineer and the architect design the fixed facilities that compose the nation's physical plant; the mechanical and electrical engineers animate them for usefulness; the mining and chemical engineers provide the materials required for the entire process.

It is the peculiar function of construction to realize engineering designs — that is, to assemble the labor, materials, equipment and the specialized skills and management required to convert those designs into the fixed structures and facilities that we see about us.

The Community Services

As one measure of the task performed by the construction industry in building the America that we know, let us take a quick look at some of the essential services it provides to make community living possible and to

make our people more productive and efficient.

Water Supply. In 1850, a century ago, there were only about 100 water works in the United States. In 1885, there were about 1,000; in 1895, about 3,000; and in 1924, about 9,000. Today, there are perhaps 12,000.

Less important, however, than the number, is the improved quality of the water supplied to our communities. When filtration was introduced early in the century in Philadelphia, the number of typhoid cases dropped within less than five years from over 600 per 100,000 to less than 100, and within the next 20 years to practically none. Typhoid deaths traceable to water supplies are practically unheard of in America today. Other water-borne diseases also are rapidly disappearing.

As the cities outgrew their nearby water sources, it became necessary for them to go farther and farther afield to find adequate supplies of pure water. New York City draws Delaware River water through the world's longest tunnel, 85 miles in length. Los Angeles taps the Colorado River 400 miles away. Denver brings its water from the other side of the Continental Divide.

Sewage Disposal. The increasing consumption of water by our cities and towns made necessary corresponding improvement of their facilities for sewage disposal. In the early days, most raw sewage was dumped in the nearby streams. But these streams eventually were needed to supply pure water for other communities. It was in 1886 that the Lawrence (Mass.) Experiment Station marked the beginning of advanced sewage disposal practice in the United States. Today, while there is still room for more improvement, modern sanitation has made city living safer and more healthful than in many rural communities.

Transportation. Scarcely less vital is the matter of transportation. Residents of the modern city must be able to get to their work and home again, and their food and other supplies must be conveyed to convenient points of wholesale and retail distribution. Early in our urban development, the horse-drawn conveyance gave way to the electric streetcar. Later the streetcar, with its tracks built into the pavements, gave way to the bus. In some of the larger communities, speedy long-distance transportation was forced overhead or underground on rapid transit railroads. And as the individual motor car achieved all but universal acceptance, it became necessary to build expressways through and around our cities. The first of these appeared in St. Louis in 1936.

As efficient transportation is necessary to the functioning of each single community, it was equally essential to provide transportation for freight as well as passengers between communities and to every region of an expanding country. Its first expression was through turnpikes and Conestoga wagons, then through canals. The first half of the hundred years that we celebrate was the great railroad building era which first connected the inland regions with the Eastern Seaboard, and then tied together the Atlantic and the Pacific regions into one nation. Next, the motor car brought the roads, and better roads fostered the expanding use of more motor cars. By the time the railroads had finished their building, they had spread a net of some 224,000 miles of line across the country. Today, this is supplemented by 3,000,000 miles of highways, some of them six- and eight-lane freeways, that frequently cost $1,000,000 a mile to construct, and sometimes as much as $5,000,000.

Reclamation and Flood Control. As the railroads and the highways opened up new land, there arose a greater demand for reclaiming large areas from desert and marsh. In 1902, a national reclamation act was passed, and then we entered a half century period of dam and reservoir building to impound the waters needed by the new land. All these structures required their quota of canal and pumping-plant construction.

As the early settlements, first located in the river valleys, were developed into great cities and fertile farmlands, the problem of flood control raised its head. Man-made facilities had encroached on the flood plains, and flood damage became a substantial item in the national economy. Levees were built to confine the streams. More frequently than not, they failed to curb the peak flood flows. This in turn made it necessary to build dams to hold back some of the flood flow. As reclamation and flood control dams harnessed more and more of our streams, the possibility of using their impounded waters to generate electric power was widely preached. Soon this became as important a factor in river control as flood prevention or irrigation.

Construction as an Industry

All these services and facilities and many more were the products of construction. They either created new wealth or conserved wealth already in being. Thus an America, dependent on construction to provide the physical facilities essential to its growth, nourished a construction industry of unprecedented skill and capacity.

How Big Is the Construction Industry in the United States?

Men

7,000 contractors on heavy construction
38,000 building contractors
200,000 special trades contractors
3,000,000 workers employed

Money

4 billion dollars worth of construction equipment in use
31 billion dollars worth of new construction in 1951

Materials

200 million bbls of cement bought and installed
3 million tons of fabricated structural steel erected

Equipment

2 million pieces of heavy construction equipment in use, which include:
900,000 trucks and 245,000 tractors
130,000 pumps and 120,000 concrete mixers
78,000 motor graders and 47,000 heavy-duty shovels and cranes
42,000 air compressors

So we come to construction in its second aspect. What are the dimensions of this industry which performs the vital function of providing and keeping up to date the physical plant that contributes so much to our material and economic progress?

As of 1951, the three largest industries in the American economy were:

1. Metal working in all its branches.
2. Manufactured foods and beverages.
3. Construction.

The total output of our economy in 1951 was $329 billion, and construction accounted for $40.6 billion or 12.3 percent. Of this 12.3 percent, 9.1 percent or $31 billion went for new construction and 3.2 percent for maintenance and repair.

The established contractors and speculative builders of America include some 245,000 private businesses, ranging from very small to very large. From their nature, construction operations must be performed at the site of the project. No substantial part of the total ever can be concentrated under one roof or in one city. Thus the construction industry is and must remain a dispersed industry, a stronghold of competitive effort and of individual free enterprise.

Contrary to the impression held by many uninformed persons, the construction industry is not a happy hunting ground for fly-by-night operators. Any industry that must operate on a job to job basis, that is highly competitive, that must frequently get its jobs by open bidding, and that is composed of a large number of small specialized units, will, from its nature, be subject to a greater turnover than a more stable, fixed industry such as manufacturing.

Despite that, however, some of the largest contracting firms in the country have been in business for many years. One of the largest has been in operation almost a century and a quarter. Many, from small beginnings, have grown into great operations. One of these companies in its first year, 1942, handled $5,000 worth of work. In 1951, its 60th year, the same company completed work valued at $412 million dollars, of which $82 million was in foreign countries.

But many of the very large construction projects of our time have outgrown in size and financial risk the capacity of the single construction company. In reply to this challenge, the industry has devised a flexible system of joint ventures whereby several companies pool their technical brains, their capital, and their equipment to bid on a particular job and carry it through to completion. The Grand Coulee Dam, greatest concrete dam in the world, is an example of such a project, involving the cooperation of ten companies, each a large operator in its own right, from six states.

At this time known projects, proposed for future construction, top $65.3 billion, exclusive of housing and smaller local projects. This is only a quarter of the estimated need for public and private heavy construction during the next few years. As an industry, construction is one of our largest and most essential. The extent and size of the construction industry in the United States are indicated in the box on page 37.

Construction and the National Economy

Finally, let us look at construction as a factor in the national economy. It is an axiom of American business that a large construction volume and mounting prosperity go hand in hand. Which of the two is the cause and which the effect is a subject of perennial debate. There are good arguments on both sides.

In the short term, it is certain that the demands and the psychology of a swelling boom tend to foster new construction projects. To that degree, the construction volume is the result of the boom. But in the long term, it is equally certain that the consistent development of new products, coupled with rising efficiency and productivity in industry, creates the additional purchasing power that makes for higher standards of living and business activity. And, as we know, construction plays an essential role in this modernization of our productive processes.

An Expanding Economy

Most Americans understand pretty well that the consistent maintenance and elevation of high living standards must result from an expanding economy. But it is not so clear just what that term means and just what creates an expanding economy.

Many conditions may account for the continuing infusion of new wealth that makes for an expanding economy. In the sixteenth century, Europe enjoyed an expanding economy based on the discovery of new lands and new wealth in the Western Hemisphere and elsewhere in the formerly unknown world. In the nineteenth century, the United States had an expanding economy based on the opening of the West with its new lands and new wealth together with the stimulation of wealth production by the invention of mechanical power.

In the twentieth century, we are still—or, if you prefer, again—in an expanding economy, although it is not based on the discovery of new natural wealth. To be sure, there still are some geographical areas to be exploited and there still is room for more intensive cultivation of the known areas. But our present expanding economy is based, for the most part, on technology—that is, the findings of the scientists as translated by our engineers and our industries into new forms of wealth and greater capacity to produce.

As we have noted in our quick review of construction in the development of America, it is in large measure through construction that we are able to put our progress in scientific knowledge to work. It is the builder who provides so many of the works and facilities that enable us to increase our output and to derive more production from every hour's work.

New construction accounts for almost half of all private investment. Gross private domestic investment, not counting inventories, is estimated at $48.2 billion for 1951. Of this amount, 18.3 percent, or $23 billion, was spent for privately financed new construction and the rest for machinery and other producers' durable equipment.

This is a never-ending process so long as our technology continues to spark and fuel an expanding economy. For the purpose and the effect of technical progress is to make obsolete the standards and methods of yesterday. New discoveries make possible new products and services. They make possible more efficient and more productive machines and other facilities. This constant replacement of the outmoded by what is newer and better is the outward and visible sign of the expanding economy. And construction is one of its major indicators. It is a measure of the nation's standard of living.

It is impossible to measure the effect of construction on the overall productivity of the American economy. But it is clear that continued expansion of industry depends upon the maintenance and expansion of power, transportation and other facilities provided by the construction industry. And the health and happiness—the incentives of the work force are closely bound up with the existence of an adequate and expanding supply of good homes, schools, hospitals, highways and community facilities.

But the short term impact of con-

struction when it is stepped up as the result of a boom tends to create an instability in the economic cycle that is the most vulnerable feature of our economy. We know that expenditures for new construction are subject to much greater fluctuation than those experienced by most other segments of the economy. Note that between 1929 and 1933 the physical volume of new construction dropped 68 percent while the gross national product (in constant dollars) fell only 28 percent. During the recovery period 1933–1937, the gross national product rose by 43 percent while new construction shot up by 104 percent. During the prosperous nineteen twenties, new construction was about 11 percent of the gross national product; during the nineteen thirties, it dropped to 6 percent. In passing, it is worth while to note that recently the new construction share of our business activity has been in the bracket of 8 to 9 percent.

Moreover, as construction constitutes more than 12 percent of the gross national product, and its workers are more than 5 percent of those gainfully employed, such swings exert a heavy influence on the national economy as a whole.

The effect is even more widespread than these figures indicate. For every five workers directly employed in construction, we have another six workers in the industries that supply materials and equipment who are severely affected by its fluctuations. Thus, about 10 to 11 percent of the labor force are dependent in some degree on construction for their jobs.

These extreme fluctuations are not inevitable. The construction industry and the federal government now have the means, between them, to cut the ups and downs substantially. Government can help primarily in two ways:

1. It can concentrate its own major construction programs as much as possible in periods when other construction activity is lowest.

2. It can use its system of mortgage guarantees and its control of the interest rate and the supply of credit to help stabilize homebuilding.

Industry can do its part in promoting stability by keeping construction costs down and by continually searching for new ways to make a better product.

One way to smooth out homebuilding is to broaden the market for homes by developing a replacement market, and lower costs are likely to be the way to that market. Much of our present housing is inadequate, but it often is not replaced simply because the homebuilding industry cannot provide better housing at a cost people are willing to pay. Prices and rents for existing dwellings will probably be lower in the future as more vacancies appear, and builders will have to cut the cost of new homes if they want to compete with these older dwellings.

The housing industry and the people who make its materials have developed many new techniques to bring costs down. Still more needs to be done along these lines, and more progress must be made in eliminating restrictive union practices and obsolete building codes that now curb the use of superior methods.

Determined application of cost-reducing techniques could also develop a larger replacement market for industrial and commercial buildings. Manufacturers can often improve their productive efficiency by moving into a well-designed new building. Retail stores also can improve sales and save on overhead in a modern structure. But companies will not be interested in moving into new buildings unless their cost is reasonable in relation to the savings they make possible—hence the need for lowering costs.

What of the Future

The facts, however, outweigh the problems. Our higher standards of living depend on an expanding economy. Construction has been a dynamic force in assuring such an expansion. How can it continue to play an equally vital role in the future?

For most of the past century, its nourishment was drawn from an urge to exploit the ever-widening geographic frontiers. It was new cities that required new water supplies and sewage plants. The railroad and the highway reached out into virgin territory. The new land needed the quickening waters of the reclamation projects, the growing settlements needed protection from floods, and sought new sources of power. But today the original facilities of our country have been constructed. The day of providing new facilities in open, uninhabited territory is about over. Where does construction go from here?

To a considerable degree, it must work back over the same area to rebuild to ever higher standards. But even more important, it must provide the new facilities demanded by a people who are seeking higher living standards, who are intent on achieving a higher degree of national security in a disturbed world, and who command the ever-increasing productivity that is necessary to realize those objectives.

In the domain of homebuilding alone, it is safe to say that no more than a few hundred thousand persons have the home of their dreams. A hundred million others will not be satisfied until they are housed in a manner more in keeping with twentieth century standards.

The modernization of existing facilities and the construction of new ones point to as big a job in the partially built United States of 1952 as that accomplished to provide the bare necessities during the pioneer period of the past century. At that time expanding geographic frontiers offered an opportunity for the construction industry to grow as it built the physical plant of a new nation. But now the new frontiers of technology are no less challenging, and the opportunity is at hand to rebuild that plant to meet the aspirations of a people who never have been willing to accept for tomorrow the living standards of today.

The basis of this hope for the future of our country, as well as of construction, is implicit in the character of the American economic system with its distinctive reliance upon freedom for the individual. As we have seen, construction genius has played an important part in building our country to its present high level of productivity. Other factors also have helped. Natural resources, human labor, funds for investment, and powerful incentives. But none of these was new in the history of the world. They all had played their parts in the development of other nations in other eras. In the case of the United States, the new factor was individual and personal opportunity; equal opportunity for every individual to shape his own destiny, and to rise as high as he could through his own intelligence, skill, and willingness to work. On such equality of opportunity our American enterprise system has been founded.

And just as the amazing physical expansion of our country during the last century derived in large measure from this atmosphere of individual freedom, we may be certain that a continued expansion, now arising from our scientific and technological progress, will find its chief motive power in that same freedom of mind and spirit. Let us guard well this well spring of our national genius.

(This article was first presented as an address by the author in the Symposium on Structures and Construction during the Centennial Convention in Chicago.)

A large block of potential firm hydro power in British Columbia attracted the aluminum smelting industry to set up a smelter on Pacific Ocean tidewater at Kitimat, near Prince Rupert, British Columbia, 500 miles north of Vancouver. Bauxite mined in Jamaica and British Guiana will be processed to alumina in a new Jamaican plant and then shipped by ocean freighter through Panama Canal to Kitimat smelting plant. There it will be reduced to ingots in electric furnaces. Anticipating an ultimate plant capacity of 500,000 tons per year, a city of 50,000 is planned at Kitimat. From an engineering and construction standpoint this hydroelectric project is a major challenge.

Fig. 2

Fig. 3

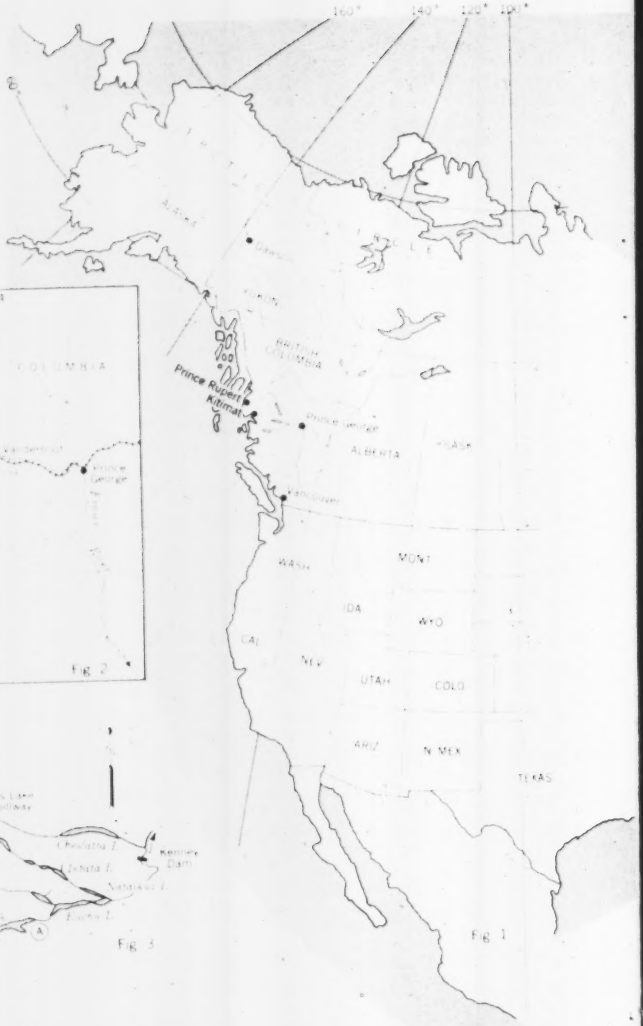

Fig. 1

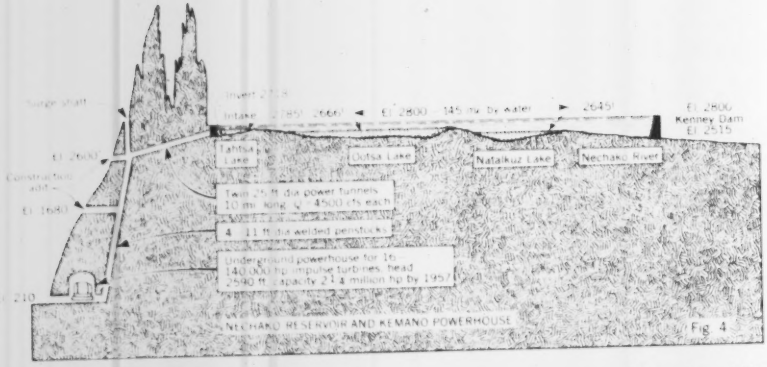

Fig. 4

Alcan—British Columbia power project under construction

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Half-billion-dollar aluminum production facility privately financed

One of the world's largest power developments, and certainly one of the more spectacular engineering-construction jobs of the decade is well under way in the rugged and almost unpopulated Tweedsmuir Park area of central British Columbia. (See Fig. 1, opposite page.) It is best known on the West Coast as the Alcan Project—deriving from the name of the owner, The Aluminum Company of Canada, Ltd., with main offices in Montreal, and now operating well over a million kilowatts on the Saguenay River. This is a subsidiary of Aluminum Limited.

The development will harness one of the several very large waterpower potentials in this province of abundant natural resources and great spaces. Damming of the Nechako River, a tributary of the Fraser, at a point about 120 miles west of Prince George (Fig. 2), will create a reservoir with a surface area of 335 sq miles at El. 2,800. The west end of this reservoir will be tapped by a tunnel and penstock system, together about 11 miles long, extending through the Coast Range to an underground powerhouse in the Kemano River Valley, which drains to the Pacific Ocean. The ultimate installation will be 16 four-nozzle vertical-shaft impulse turbines, each with a capacity of 140,000 hp, to operate under a nominal gross head of 2,590 ft, at a speed of 327.5 rpm. Alternators will be rated 106,000 kva, 0.8 power factor with a 60-deg rise, or 122,000 kva, 0.8 power factor with an 80-deg rise, to generate at 13.8 kv with step-up to 287 kv for transmission a distance of 50 miles, over the heaviest lines known to have been considered anywhere.

The total energy available from the site is estimated at 1,670,000 firm electrical hp, delivered at an aluminum smelting plant to be constructed at the head of Kitimat Arm about 45 miles south of Terrace, B.C., simultaneously with the power facilities.

Extensive Early Investigations

The existence of large sources of water power in the high-level lakes just inland from the heads of deep inlets or fjords along the coast of British Columbia was recognized early in the century, and extensive surveys were carried out by the Water Rights Branch of the Provincial Department of Lands and Forests in 1928, 1930, and 1938-1939. Comprehensive reports based on these surveys were brought to the attention of Alcan first in 1948 and again after the close of World War II, with the result that engineers and geologists made a reconnaissance of the Chilco Lake and Tweedsmuir Park potentials during the summer of 1948, using seaplanes, pack horses and boats to travel some 12,000 miles throughout this sparsely populated region of myriad lakes, plunging streams, and ice-capped mountains, where scenic beauty abounds in almost infinite variety.

The Chilco Lake schemes appeared less promising because of the expense of access, effects on salmon fisheries, energy limitation to about 900,000 hp, and lack of a suitable site for the smelting plant and town. Accordingly, attention was concentrated on the numerous dam, tunnel, and power plant sites included in the reports of the Provincial Government on the Tweedsmuir Park schemes. These made use of the Tahtsa Lake and River water in each of two major combinations for stage-development of the potential of Eutsuk and Whitesail lakes.

For diversion by tunnel south from Eutsuk Lake to the Kimsquit River, the Eutsuk-Kimsquit Project (see Figs. 2 and 3), the suggested stages were as follows:

Steps	Catchment	Flow in cfs	Structures
No. 1	Eutsuk-Tetachuck	2,350	Dam at (A)
No. 2	Whitesail Lake	1,150	Dam at (C), Channel Cut (B)
No. 3	Tahtsa River	1,900	Tunnel (D), Dam (E)
	Total	5,400 = 1,100,000 firm hp	

For diversion by tunnel from the west end of Tahtsa Lake—the Tahtsa-Kemano Project—the stages were:

Steps	Catchment	Flow in cfs	Structures
No. 1	Tahtsa Lake	1,000	Dam (F)
No. 2	Tahtsa River	900	Dam (E)
No. 3	Nanika Lake	1,000	Tunnel (G), Dam (H)
	Total	2,900 = 685,000 hp	

Nanika Lake could have been diverted to enlarge the Kimsquit combination to 6,400 cfs, and by reversing the direction of flow, Eutsuk and Whitesail water could have been brought into the Tahtsa-Kemano combination to provide a total of 1,515,000 firm hp at Kemano.

Nechako-Kemano-Kitimat Plan Favored for Economy

Although the cost of transmission from Kimsquit to the Dean Channel would have been less than from Kemano to Kitimat, the requisite 10,000

forested land suitable for a town of, eventually, 30,000 people and a smelting plant at tidewater, with an ultimate original capacity of 300,000 tpy of aluminum. Work started early at Kitimat. The latter plus the additional head of water for the same water established the Kemano site as the choice for power generation.

The great cost of opening up this vast area for so many major construction operations was apparent in the first comparative cost estimates prepared by the International Engineering Co. Inc. of San Francisco, as part of the 1948–1949 Project Report which brought out the several economic advantages of a single larger dam on the Nechako River which drains all the lakes except Nanika. This more comprehensive plan of development utilized the entire potential, created the maximum storage for regulation, and showed the lowest construction cost per unit horsepower, but of course could be justified only by an equally considered estimate of market for the power. The project is economically feasible for only a large installation and a steady load near the power source. To reverse the usual order, the aluminum smelting industry is ideally suited to the development of the Nechako water power potential.

Further investigations were directed towards proving up the engineering and construction features of the Nechako-Kitimat combination. Following the reconnaissance in 1948, Alcan retained British Columbia International Engineering Co., Ltd., of Vancouver, B.C., to continue investigation of the power aspects of the project. In 1949, Butte dam site on the upper Nechako and an alternate site at the outlet of Intata Lake were surveyed, drilled, and shown to be unfavorable, and exploration was started on the Canyon dam site downstream. All possible routes for the Kemano-Kitimat transmission line were reconnoitered by helicopter. Office studies were refined and a report prepared on the Nechako-Kemano-Kitimat Project only.

Items of the investigation scheduled and completed in 1950 included additional aerial mapping of flowage, surveying and drilling at Canyon, Ealtsa, Nanika, and the saddle dam sites at Ootsa Lake. Recording gages were installed on Nanika River, the outlet of Ealtsa Lake, the outlet of Ootsa Lake, and on the main Nechako near the dam site. Alcan engineers began a study of weather conditions in the more mountainous section of the proposed transmission line route. A weather station was built at El. 3,500 and manned throughout the winter of 1950-1951, and an automatic ice-load recorder was developed and erected at the pass, El. 5,300, which showed a maximum of 2.4 lb of ice or rime per ft on a 25-ft length of 79,000 circular mils, aluminum conductor, steel reinforced, during the one season. The easterly 35 miles of the line were also traversed on foot by a party which back packed supplies delivered by helicopter.

Investigation work at the powerhouse, which was scheduled for the 1951 field season, had to be started in February 1951 and continued concurrently with construction. This included surveying at the intake, tunnel, and powerhouse sites, core drilling, surveys for Kemano Road and pier, and preliminary location for the transmission line. A third project report was issued in June 1951, and drilling and exploration of saddle-dam sites plus certain items of project planning were advanced.

The project area lies along north latitude 53° 30' between west longitude 125° 00' and west longitude 128° 00', extending from the Pacific coastal waters eastward almost to the Fraser River Valley. The very rough and precipitous granite remnants of the British Columbia coast batholith occur at tidewater and continue inland to ring the westerly ends of Eutsuk and Whitesail lakes, where they give way to the older Hazelton formations of sediments and extrusives. Basalts and lavas form much of the cap rock along the rim of the reservoir, which slopes rather gently downward towards the east. Continental and alpine glaciation profoundly influenced the topography, carving the fjords, striating the plateaus and filling the ancient valleys with debris to form the many lakes of Tweedsmuir Park, and produce the remarkably low gradient of the drainage system. The depth of this glacial debris is over 300 ft at the Butte dam site.

East of the Coast Mountains, the soil is generally thin and lean, but well covered with small spruce and jack pine. However, in the coastal valleys, as along the Kemano and Kitimat rivers, the heavier rainfall and alluvial soil support virgin stands of big spruce, hemlock, and cedar.

Grizzly and black bears, wolves, coyotes, moose, deer, mountain goats, and smaller fur-bearing animals roam here almost unmolested by man, and the streams and lakes are a fisherman's paradise. The Coast Mountains intercept 100 in. or more of precipitation annually, and the tops are covered with great depths of snow ten months each year. Eastward in the reservoir areas, the average annual precipitation falls to 18 in., but winter temperatures range as low as −70 deg F and ice on the lakes does not break up until mid-May. All in all, this virgin wilderness presents a challenge to modern construction equipment and the hardiest of construction men.

The catchment area of the Nechako River system above the canyon dam site is 5,475 miles, and the Nanika catchment is 290 sq miles. The westerly 1,940 sq miles, or Eutsuk-Ealtsa-Whitesail portions of the Nechako area, supply about 80 per-

Main storage dam for Nechako Reservoir, rockfill structure containing about 4,000,000 cu yd of embankment, will be completed during 1952. View taken in January 1952 shows upstream cofferdam in foreground and, at left, intake to diversion tunnel. At right, core-trench preparation and foundation grouting proceed under winterized cover.

cent of the total runoff, testifying to the hydrological effects of the warm and humid air currents from the Pacific.

The total water supply included in the Nechako-Kitimat Project can be divided for development into three parts or stages, as follows: Tahtsa Lake alone, about 1,000 cfs; the remainder of Nechako runoff, 5,000 cfs; and finally the 1,000 cfs from Namika.

Construction of the Tahtsa stage was authorized early in 1951, and preparations for the dam on the Nechako were started at the same time so that 6,000 cfs will be available for firm power production when the reservoir rises enough to flow westward into the Tahtsa Lake basin.

Recording gages have been maintained by the Canadian Government on the Tahtsa, Whitesail and Tetachuck rivers, and a staff gage at the outlet of Ootsa Lake for about 20 years. Unfortunately, the gages could not be serviced frequently enough to avoid some breaks in the runoff record. Gaps were filled in by correlation and summaries correlated to the 29 year record at Fort Fraser, 50 miles downstream from the canyon dam site. The net effect of glacial recession is estimated at less than 1 percent.

The only rail access to the project area is from the Canadian National Railway line from Jasper, Alberta, to Prince Rupert, passing about 50 miles north of the dam sites and 42 miles north of the Kitimat plant site, which will be served by a branch line.

The railway is paralleled by a public gravel highway, with a branch to Ootsa Lake, and another to Lakelse, 17 miles south of Terrace, B.C. Water transport in the reservoir area is limited to small loads by the size of the streams connecting the several lakes, but the lakes themselves serve as convenient landing fields for medium planes equipped with skis or floats. Kemano Bay and Kitimat Arm afford ample depth for seagoing craft.

The development as now being designed and constructed is a combination of Stages 1 and 2, or Tahtsa plus Nechako. Kenney Dam on the Nechako will impound water enough to develop 1,430,000 firm hp beginning in 1955, but only three units of generating equipment are being installed under the present program. The first two of these units are scheduled for operation in April 1954.

Rockfill Storage Dam Nearly Completed

The main and saddle dams will create the Nechako Reservoir by a surcharge on the natural lakes and flooding out the connecting streams. About 20,000,000 acre-ft, or five years' average runoff, will be required to fill the reservoir to spillway crest at El. 2,800. (See Fig. 4.) At this level, the distance measured along the original water courses will be 145 miles from Kenney Dam to the power tunnel intakes at the west end of Tahtsa Lake. This main dam will be 325 ft high above the lowest part of the foundations and about 1,500 ft long at the crest. The section is of the rock-fill, sloping-core type, with extra flat slopes of 1:2.5 upstream and 1:1.75 downstream, and will be founded on a series of basalts, which will be quarried nearby for the rock-fill portions. Adense and stable boulder clay for the core, and gravels for filter zones, are also available near the site. The total volume of the embankment approximates 4,000,000 cu yd, all of which is scheduled to be placed in the 1952 construction season.

In the first year of operations, Mannix Ltd., of Calgary, Alberta, built 60 miles of good road from Vanderhoof, B.C., to the dam site; graded a plane runway; completed diversion of the river through a 32-ft-dia tunnel 1,500 ft long; stripped about 800,000 cu yd from the abutments; opened a quarry; and stockpiled filter material. About 600 men were employed throughout the 1951-1952 winter for foundation grouting, quarry stripping, and other work preparatory to completion of the job on a fast schedule during the 1952 season. About 70 percent of the embankment is now in place and closure was made early in October 1952 to begin storage of water.

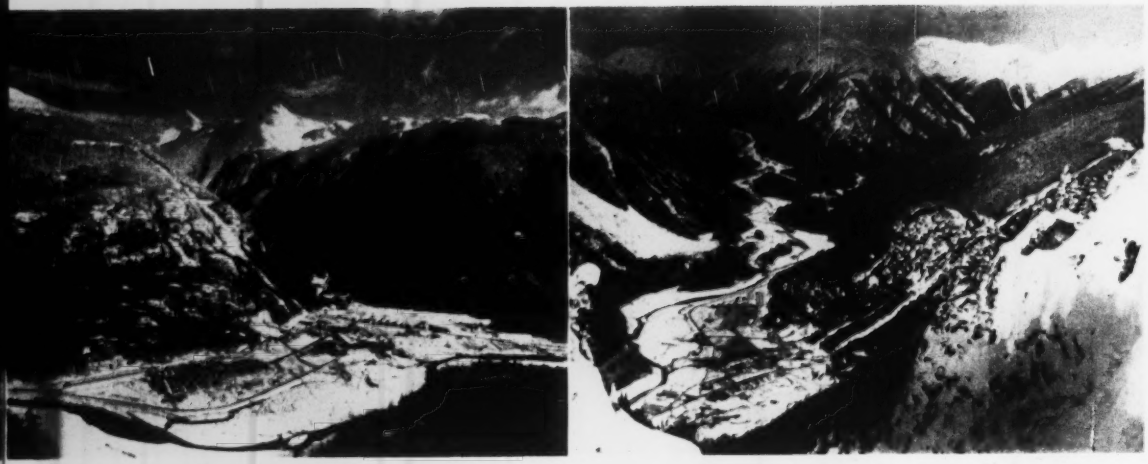
Several saddle dams of the fill type will be required to close the reservoir in the broken ground along the north side of Ootsa Lake, and the main flood spillway for the reservoir will be located on rock in this area to discharge through Skins Lake and Cheslatta Lake into the Nechako River six miles below Kenney Dam.

The expected annual drawdown of the reservoir is about 7 ft and the extreme condition of a 7-year drought would lower the reservoir only 17 ft. Since the natural level of Tahtsa Lake is El. 2,785, it follows that no large cut will be required at the outlet of the lake to pass water from downstream storage unless water in excess of the Tahtsa Lake flow and storage is required for power production before the Nechako Reservoir can fill to that level about 4.5 years after closure of the main dam. The date of the production of power from water in excess of the Tahtsa Lake inflow is dependent upon the filling of dead storage in the reservoir, but could be accelerated nine months by drawing down Eutsuk Lake through a cut to Whitesail Lake.

Power Tunnels of Record Size

The intake is being constructed at the west end of Tahtsa Lake, and equipped initially to supply both of the main power tunnels, with only a short length of the future No. 2 tunnel driven beyond the intake gates. The gate structure will be in rock at the foot of a mountain, and part of the 700-ft-long headrace channel will also be in rock cut. Access to the intake end of the tunnels required about

By September of this year Kenney Dam, forming Nechako Reservoir, had reached 230 ft above foundation. Equipment placing core material can be seen just below skyline, in photograph at right. Finished height of 325 ft is exceeded among rock-fill dams only by San Gabriel No. 1 and by Salt Springs dams in California.



50 miles of new road to the east end of Tahtsa Lake and a water haul of 20 miles on the lake to the west end. Two steel barges of 100 ton capacity, driven by sea mules, were trucked in for this transport service.

The ultimate twin power tunnels, of modified 25-ft horseshoe section and 10.0 miles long, may be the largest in capacity ever driven to supply a water power plant. They will be nominally unlined except for pavement, will be spaced 300 ft apart, and on a uniform grade of 0.00275. Each is designed to carry a maximum of 4,500 cfs although the normal full load will be 3,500 cfs, or half the total firm supply including Nanika. Excavation of Tunnel No. 1, or the northerly tunnel, is progressing from four headings, westerly from the intake, both directions from Horetzky Adit near the 5-mile point, and easterly from the surge shaft end above Kemano Valley. The center and west access adits are at main tunnel grade, while access at the intake end is gained through a ramp about 1,000 ft long.

At the west, or powerhouse end, Tunnel No. 1 will branch to two 15-ft 0-in. butterfly valves, each in the line of a steel penstock of the same diameter, placed in a sloping shaft. Both shafts will be excavated but lining will be installed initially only for No. 1 penstock. The total length of this 15-ft 0-in. pipe will be about 1,160 ft, and plate thicknesses will vary from $^{3}/_{16}$ in. to $1^{3}/_{16}$ in. with increase in head. Wye branches and a main bold at El. 210 effect reductions to 5-ft 6-in. in diameter upstream of the 54-in. double-seal sphere valves, which are connected to turbine scrolls by branches of 5 ft 0 in. diameter about 100 ft long.

Liner sections will be shop fabricated in cylinders having a maximum weight of 20 tons or a length of 28 ft, and will be welded at the adit portals into subassemblies of two shop sections each. Welding of circumferential joints in the shaft will be entirely from the inside of the liner.

The upper part of the shaft is being raised from an adit at El. 1,680, and the remainder will be raised from turbine level, El. 210. The adits at Els. 1,680 and 2,600 are serviced from an aerial tramway of 20 ton capacity, designed for the transport of construction equipment and supplies, penstock sections, valves, and concrete materials to the two adit levels for lowering to position inside the shaft.

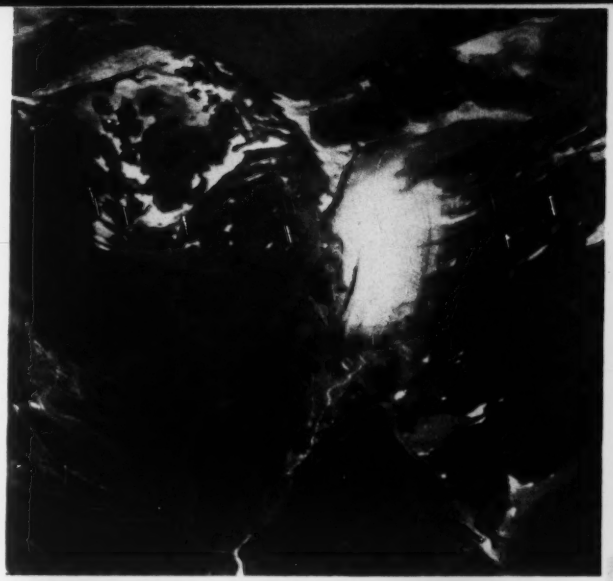
Underground Powerhouse Is Important Feature

The ultimate powerhouse will be a chamber 1,100 ft long, about 82 ft wide and 138 ft high, excavated in granodiorite. There will be space for eight units on each side of a central service and control bay. Long hole drilling techniques are being employed in chamber excavation. Only unit bays Nos. 1 to 8, and the service bay, will be constructed under the present contract. Location and orientation of this large chamber were fixed after driving an exploratory drift 1,500 ft long into the mountain at spring line elevation, and extensive diamond drilling. The main access tunnel is about 1,450 ft long, and the tailwater tunnels reach daylight about 100 ft further towards the Kemano River.

The roof arch will be concrete lined throughout the length of the chamber. A false ceiling in the form of an arch will be provided over the generating room, and curtain walls will screen the vertical rock faces of the cavern. Three vertical shaft impulse units will be installed initially, one each of three makes of generators and three makes of turbine. Units will be connected in pairs to banks of single-phase, double-primary 71,000-87,500 kva, 13.8-287-kv transformers in vaults along the downstream side of the chamber. Energy will be transmitted to an outdoor switchyard of aluminum structures through 2,200 ft of single-core, 301-kv oil-filled cable on racks in a tunnel. Generator and high tension breakers will be of the air-blast type.

High Terrain Requires Rugged Transmission Line

Over a large part of the transmission line route from Kemano to Kitimat, the terrain affords space for only two tower lines. The ultimate output of 1,200,000 kw will be carried over the 10.5 miles of the more difficult high ground on two single-circuit lines, both of which will be installed initially. In order to insure continuity of service, conductors will be 3,364 thousand circular mils, aluminum conductor, steel reinforced, designed for a breaking load of 40 lb per ft of ice or rime and requiring up to six strings of 25,000 lb insulators.



Far Left

Kemano underground powerhouse will have ultimate capacity of sixteen 140,000-hp impulse turbines operating on 2,590-ft head. Photo taken in February shows adit of main tunnel (first of two), 10 miles long, at El. 2,600 ft; adit for penstock driving, at El. 1,685; and entrance to tunnel leading to underground powerhouse. Aerial tramway from valley floor services upper adits. Twin snow-covered peaks in background are the Jaws.

Left

At Kemano powerhouse site, aerial tramway, construction camp, and operators' village are in foreground. Kemano River Valley, at left, leading to Kildala Pass, at extreme left, is route of transmission line to Kitimat smelter site 50 miles away.

Right

Kildala Pass, at El. 5,300, is seen in center at left of glacier. Beyond the pass is Kemano River and powerhouse site. Unusually heavy transmission line is designed for this crossing.

Construction is well started on one line of steel towers, of two general types. The suspension, light-angle type will weigh about 33 tons each and the heavy-angle, strain type will be proportionately heavier, depending on height. The parallel second line employs a new type of braced H-frame tower made up of five or six thin-walled aluminum tubes 38 in. in diameter with a box-girder cross arm. These towers weigh about 12 tons each and are designed for speedy subassembly and erection in the field. The remainder of the line, or 39 miles, will be of double circuit construction on steel towers, with only one of the two lines scheduled for this stage of the development. Here conductors will be 1,590 thousand circular mils, aluminum conductor, steel reinforced, for a maximum ice load of 24 lb per ft.

Construction of these transmission lines is a major item of work, chiefly because of the difficulty of access and the shortness of the working season in which construction can be carried out efficiently. Two Sikorsky helicopters of 1-ton capacity and several Bell helicopters have been used for transport from road termini, plus high lining and skidways. However, a road is now completed from the powerhouse over the pass to Kildala Arm, and most of the tonnage will go in by truck. Each individual tower site will be treated as a special problem for design and construction, and material and plans must be ready to complete both of these lines in 1953.

The relatively new and special engineering problems encountered in the design and construction of the hydraulic conduit, underground powerhouse, and transmission lines will be reported more fully when details are worked out.

Design of power facilities is being developed by British Columbia International Engineering Co., Ltd., Vancouver, B.C., and International Engineering Co., Inc., San Francisco, C.P. Dunn, M. ASCE, president. The writer has been in charge of the investigation and of the British Columbia office from the beginning.

P. E. Radley is manager on the project for The Aluminum Company of Canada, Ltd., and Morrison-Knudsen Co. of Canada, Ltd., is general contractor, with A. O. Strandberg as project manager.

How would you do it?

Some of the most fascinating chapters in the life and memory of an engineer are those which deal with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor.—H. J. Gilkey

An irrigation pressure tunnel was driven through rock of such excellent quality that it seemed unnecessary to line the tunnel. The tunnel proved adequate until unwatered when it caved in although the rock had not softened or otherwise altered. What was the explanation? For solution, see page 100.

Editor's Note.—This is the eighth installment of a series which started in the February 1952 issue of CIVIL ENGINEERING. In the April issue an article "The Unexpected in Engineering—The Bugs" explains the project and enlarges upon the central theme that problems of the past created the practice of the present, that "The engineering of today rests upon a coral reef, sturdy remnants of yesterday's bugs." The process is a continuing one, there will always be today's and tomorrow's bugs to add zest and gray hairs to the practice of a profession that by its very nature must cantilever from a codified past to an untried future. "Long live bugs" is an ever present challenge to the virility and ingenuity of the engineer. If you have a good bug, why not share it?—H. J. G.

The Nikkatsu International Building, completed recently, has four basement stories, nine stories above ground, plus a three-story penthouse.

ARNOLD C. MASON

Geologist-Engineer, United States Geological Survey; on assignment to Engineer Section, Headquarters, Far East Command

Open-caisson to erect Tokyo

Publication authorized by the Director, U.S. Geological Survey.

Erection of the Nikkatsu International Building in Tokyo by the open caisson method during the past year has been followed closely not only by construction men but also by the public, which has taken a keen interest in the daily progress recorded on the outside display board. Located at the principal downtown intersection in Tokyo, only 100 yd from Gen. Mark Clark's then headquarters, the below-sea-level excavation has been visited frequently by Army and Air Force engineers. Some of them have joined the sidewalk superintendents who have kept track of the sinking by missing their marks on the outside wall of the five million dollar structure.

The Nikkatsu Building occupies an entire block which has the shape of a blunted right triangle, the legs measuring 230 and 325 ft (Fig. 2). The ground area is 43,000 sq ft, approximately one acre. The building has four basement stories (Fig. 5), nine stories above ground plus a three-story penthouse, and a total floor area of about 370,000 sq ft. The first basement is a shopping arcade, and the three stories below it are a garage accommodating 200 cars. The first floor is designed for a bank and an airline office, the second through fifth floors for offices, and the sixth through ninth floors for a hotel.

Substructure Forms Caisson

In the caisson method the substructure is constructed as a unit above ground (Fig. 1), then sunk into place by excavating beneath it. Time can be saved by this method because it is not necessary to await the completion of excavation and the preparation of foundations before beginning erection of the superstructure, which can be added while the substructure is sinking. Another advantage is the elimination of the noise and vibration of driving sheet piling around the perimeter of the building site. Interference with adjacent sidewalks and streets during construction is minimized even though the building fully occupies its lot. Little or no damage is occasioned to nearby structures. Excavation is somewhat slower because it must be carefully controlled. In Japan excavation is done by hand, but mechanization is possible.

The method is suited to the emplacement of substructures in areas underlain by unconsolidated materials, such as are found in the bayhead delta of Tokyo, the lake deposits of Chicago, the alluvium of New Orleans, and the marine sediments of Houston. Since 1948 it has been utilized in Japan in the construction of 18 buildings, of which that here described is the largest.

The Nikkatsu Building is designed of latticed columns and girders encased in concrete for added strength and fire protection. The connection of girder ends to columns is made rigid by top connection angles reinforced by a welded steel plate rib. A seismic coefficient of 0.2 of gravity has been adopted from the ground story up to 52.5 ft, increasing beyond this point by 0.01 for each 13 ft of additional height. A coefficient of 0.1 is used for substructure structure.

Seismic walls have a thickness of 11 in. in the lower stories and 9 in. in the upper stories. The allowable unit stresses for steel in Japan are 22,400 psi for sustained loads and 33,000 psi for the combination of sustained load and earthquake shock.

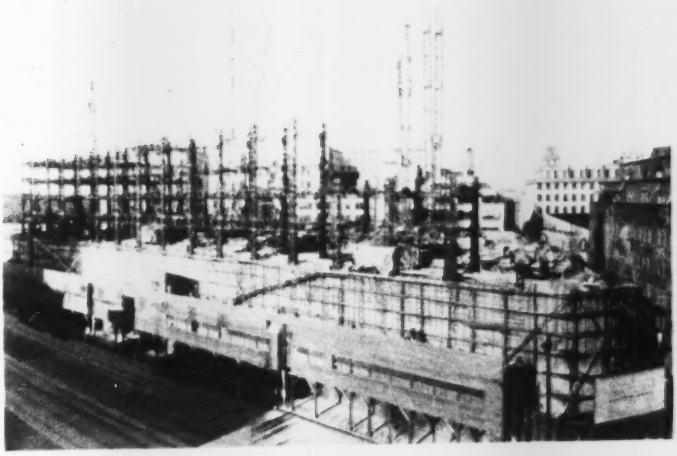
Subsurface conditions at the site were investigated in detail by means of six borings and five wells sunk to depths up to 150 ft. Briefly, beneath the oxidized surface soil, blue-gray clay carrying shells common to brackish water extends to a depth of about 50 ft, beneath which are beds of gravel and sandy gravel. The bearing power of the clay was established at 1,800 to 3,000 psi and that of the gravel at 17,000 psi. The water table was 10 ft below the surface, but no water in quantity was encountered until the gravel was reached. During construction, the water was collected in a test well and disposed of by six 6-in turbine pumps.

The caisson for the Nikkatsu Building consisted of the upper three basement stories, which were constructed above ground (Fig. 1). After concrete was poured around the steel framework, the exterior walls were waterproofed. Foundations for the interior columns and the exterior wall were constructed at the specified depth just before sinking was completed. On completion of sinking, the fourth basement story was finished by converting the lower wall of the caisson into an exterior wall, thickening the cutting edge to form a foundation, and laying the floor.

Total weight of the caisson was approximately 25,000 tons, of which the exterior walls accounted for 10,000 tons and the interior columns, girders, and bracing for 15,000 tons.

The interior of the caisson was temporarily built in the form of a truss (Fig. 1), its upper chord consisting of the crossbeams of the ground floor, and its lower chord of the crossbeams of the third basement floor, which were designed to withstand also the lateral compression to which the exterior walls would be subjected after the caisson had been sunk. Temporary diagonal bracing connected the upper and lower chords so that the interior weight was sup-

method used
office building



Concrete exterior walls of four basement floors of Nikkatsu International Building, Tokyo, formed open caisson, shown here when sinking started in December 1950. Ground floor is at bottom of steel superstructure, which was erected while caisson was being sunk. Construction offices are over sidewalk. In center background can be seen Dai Ichi Building, then headquarters of U. S. Far East Command.

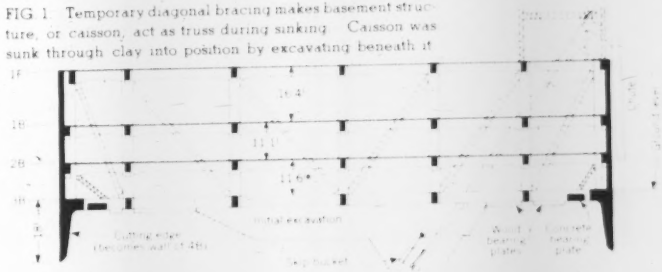
ported by the exterior wall and the adjacent bearing plates. The cost of the temporary bracing was more than offset by the elimination, through use of the caisson method, of an estimated 700 tons of sheetpiling and 1,700 tons of shoring, struts, and other materials.

The cutting edge beneath the outside wall formed a continuous footing along the perimeter of the building. It was made of concrete with a steel shoe, as shown in Fig. 3, and extended to a depth of 18 ft below the floor level of the third basement. It served not only to cut the subsoil, but also as a sheeting to keep the outside soil from sliding inward. In its lower 13 ft it was designed to taper from a thickness of 4 ft to a slightly blunt point by a slope on the inner side. As the cutting edge descended, the subsoil beneath the caisson was forced inward while the outside subsoil was left relatively undisturbed.

A protrusion on the inner side of the upper part of the cutting edge rested on unexcavated subsoil and acted as a bearing plate to carry a part of the weight of the caisson. Alongside of it, except at the three corners, a supplementary temporary wooden bearing plate was placed.

With a caisson perimeter totaling 900 lin ft, the edge and plates would bear a load of 26 tons per running foot if the load were evenly distributed around the perimeter. At the minimum bearing power of the subsoil, this would require a support width of 30 ft. However, since the side walls were nearer the center of gravity than the corners, they bore a greater weight. Therefore the concrete bearing plate was made wider along the middle of the side walls, where the cutting edge and the plate had a total width of 13 ft. Here the wooden bearing plate also reached its maximum

FIG. 1. Temporary diagonal bracing makes basement structure, or caisson, act as truss during sinking. Caisson was sunk through clay into position by excavating beneath it.



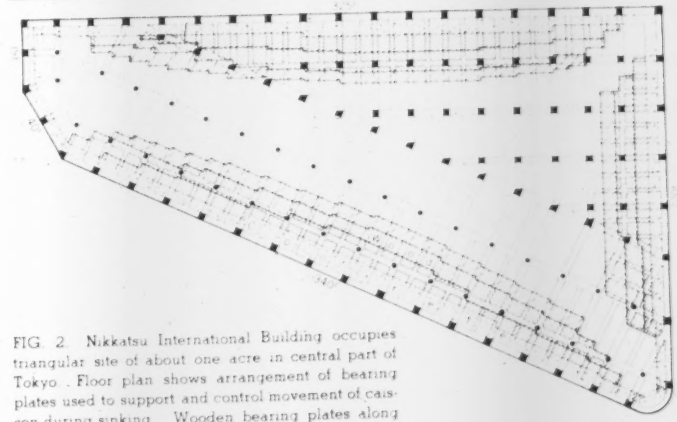


FIG. 2. Nikkatsu International Building occupies triangular site of about one acre in central part of Tokyo. Floor plan shows arrangement of bearing plates used to support and control movement of caisson during sinking. Wooden bearing plates along each side wall were removed from time to time during sinking as skin friction took more of load.

width, 20 ft. From the middle of the side walls toward the corners, the width of the wooden plate decreased. As the caisson sank and skin friction on the outside wall increased, the width of the wood plate was twice reduced along its whole length, and, when the cutting edge reached gravel, the wood plate was entirely removed.

Work started on May 20, 1950, with the pouring of the cutting edge in a trench. After the substory was erected, excavation began in steps. During each step, excavation was conducted first in the center, then out to the three corners to avoid the structural stresses that would result if the support became concentrated at these distant points, and last, from the center toward the three side walls. As long as the cutting edge was in clay, sinking took place in steps (Fig. 4).

During any one step, as excavation approached the perimeter walls, the caisson began to sink by compressing the subsoil at a very slow rate, which gradually increased until there was a sudden drop as the remaining subsoil failed and was pushed inward as an overhanging shoe. After a drop, sinking was almost negligible until about a day before the next drop. For example, the rate of sinking would become about 1 in. per hour 12 hours before a drop, and increase to about 10 in. per hour as the drop began. During the drop the rate of sinking would be about 1 in. per sec.

This sinking in the clay amounted to 36.7 ft, of which 8.9 ft occurred by compression of the soil between drops and 28.7 ft took place in 16 drops, the first being on January 7, 1951, and the last on June 8, 1951. The average drop was 1.8 ft and the maximum 3.3 ft.

After the cutting edge reached the bottom of the clay, it was sunk 2 ft more in the underlying gravel. This sinking was accomplished by merely digging a trench along the inner side of the cutting edge. Sinking closely followed the excavation in the gravel and was gradual and nearly uniform. The caisson came to its final position on June 17, 1951.

When the caisson reached bearing, the temporary interior bracing was cut out and the interior columns were then supported on the foundations prepared for them just before sinking of the caisson was completed (Fig. 3). Until these foundations were installed, there was no structure under the columns, although in earlier buildings constructed in this way imbedded cribwork was set to reassure the workmen.

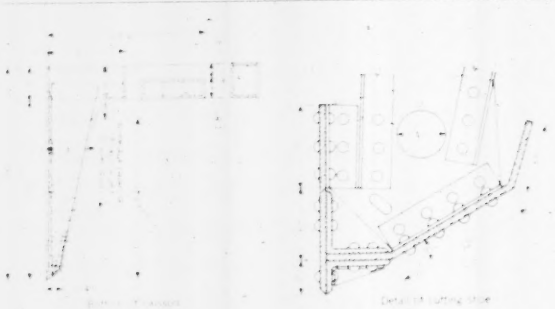


FIG. 3. Cutting edge of caisson is steel-faced concrete. After sinking, bottom edge was thickened to form foundation.

Excavation inside the caisson was done with pick and shovel. The spoil was loaded into pushcarts, dumped into skip buckets, carried to the surface, and trucked away. Excavation continued day and night. About 300 laborers were employed at the peak. From November 16, 1950, to June 21, 1951, 87,500 cu yd of earth were excavated in 38,966 man-days and hauled away in 28,943 truck loads, a daily average of 400 cu yd by 179 workers. In addition, 8,500 cu yd of surface soil were removed in clearing the site for the caisson, and 4,000 cu yd more in preparing the trench for the cutting edge, a total of 100,000 cu yd.

Around the perimeter of the building the sidewalks adjacent to the outside wall subsided rather uniformly about 6 to 7 in. as a result of the earth's being dragged down by skin friction. At a distance of 20 ft from the wall, the subsidence in the street was only about ½ in., and a little farther away none was detectable.

Continuous Recordings Made

Instruments recorded the operation continuously and furnished the information necessary to control the sinking by constantly indicating the place and amount of excavation needed. (See Fig. 4.) The control room was in the center of the caisson, and directions to the workers were announced over six loudspeakers. Sinkmeters recording to 0.01 mm, and inclinometers were installed together at five locations, at each of the three corners, at the center of the longest side, and in the control room, where all were self-registering. At each location a pile was driven in the ground for reference, and the instrument was attached to the caisson.

The inclinometers recorded their data in the control room on a display board having 5 sets of 9 lights each. The sets were mounted on the board in relative position to correspond with the position of the instruments in respect to the plan of the building. Each set was arranged with a blue light in the center, a yellow light in each cardinal direction, and beyond each yellow light a red light. When any inclinometer was tilted less than 0.001, the blue light shone at the corresponding position on the board. If the tilt exceeded 0.001, a yellow light appeared in the direction of tilt. If the tilt exceeded 0.002 a red light appeared. The maximum tilt recorded was 0.003. This was far from being dangerous, but of course any excessive tilting would create undesirable secondary stresses in the structure.

Levels were mounted on two buildings on each side as an independent check on the sinking. Strain meters were placed at 34 points on the temporary braces and on the bottom cross-beams to record unequal loading resulting from inequalities in the sinking of the outside wall during the excavation.

Nine pressure meters were placed in the bearing plate to determine the pressure exerted by the plate on the unexcavated material on which it rested. Three were also placed in the outside wall at the third basement level, and three more at the second basement level to determine the lateral push of the outside subsoil. These pressure meters had an effective diameter of 3.28 ft. When the building tilted slightly during sinking, pressure decreased noticeably on the side toward which it tilted and increased on the opposite side. At a

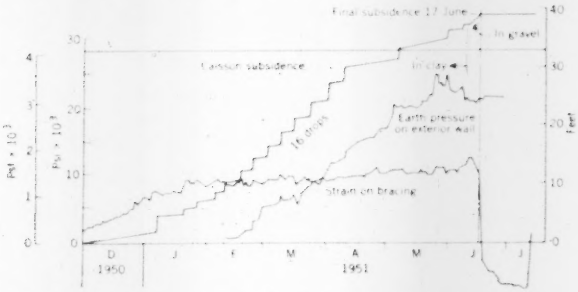


FIG. 4. Instruments continuously recorded subsidence and tilt of caisson, strain on temporary bracing, and earth pressure on exterior wall. In clay, sinking took place in steps as subsoil reached points of failure. Last 2 ft of travel, which was in gravel, was gradual.

Lowermost 2 ft of caisson's travel downward was in gravel. Here small trench dug inside cutting edge was sufficient to cause almost continuous sinking.

depth of 32.8 ft, a pressure of 3,080 psi was recorded after sinking was completed.

A three-component acceleration seismometer was installed in the building and another in a nearby park. Some mild earthquakes were recorded but none affected the sinking of the building.

The steel superstructure was erected as the building sank (Fig. 5), but concrete for the superstructure was poured after sinking was completed. The building was faced with brick tile. Exterior work was completed December 20, 1951, and the building was ready for occupancy by March 1952.

This application of the caisson principle was originated by Tsugo Ouchi, director and chief engineer of the Takenaka Construction Co., which erected the Nikkatsu Building. The method has been patented in Japan, and in the United States in 1941.

The Nikkatsu Building was designed under the supervision of Risuke Kobayashi, director and chief architect of the construction company. Dr. Tachu Naito, of Waseda University, Tokyo, was consulting engineer on structural analysis and design. Dr. John K. Minami of Waseda University, and Dr. Kano Hoshino of Tokyo University were consultants on soil studies.

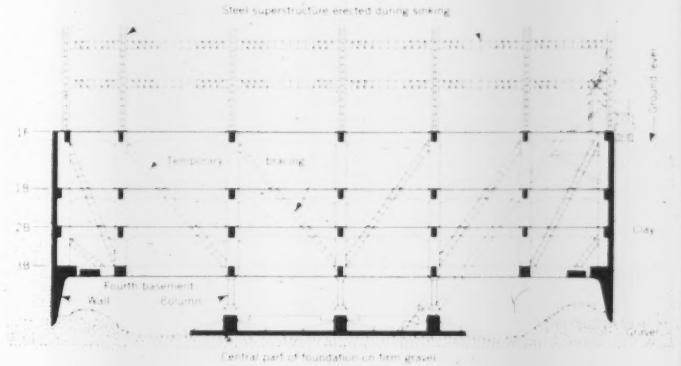
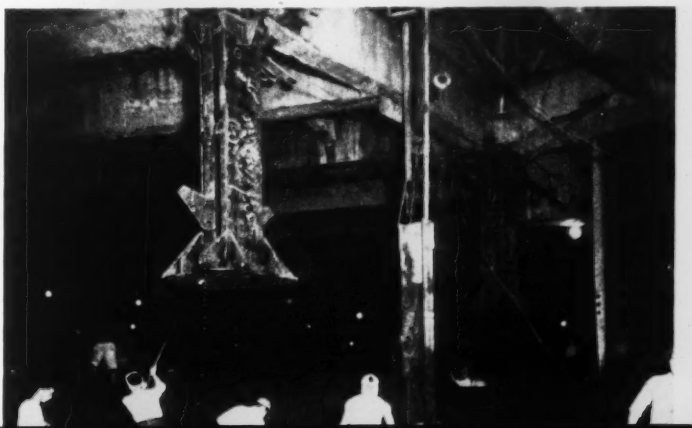


FIG. 5. As caisson neared point where it was to be founded in gravel, fourth basement was excavated and foundations prepared for interior columns. Columns were then extended downward so that they would rest on these foundations when caisson reached final position. Cutting edge then became exterior wall of lowest basement. Temporary internal bracing was removed after columns were seated on their foundations.

During last stage of sinking of caisson, interior columns were extended downward so that they would bear on previously prepared foundations when caisson reached final position. On completion of excavation, this space was floored to form fourth basement. Lower three basements are used for garage, with capacity of 200 cars.



[Editor's Note: Through the courtesy of the Takenaka Construction Co. of Tokyo and of Prof. Albert G. H. Dietz, A.M.ASCE, of Massachusetts Institute of Technology, a motion picture film taken during construction of the Nikkatsu Building has been deposited at ASCE Headquarters. This interesting 35-mm nitrate film (with sound track in Japanese) is available on a loan basis, to Local Sections and Student Chapters of ASCE, on request to the Executive Secretary at ASCE Headquarters, 33 West 39th St., New York 18, N.Y.]

Large gravity dams can now be built truly monolithically by new techniques which keep volume changes due to temperature variations within safe limits. Pine Flat Dam, seen from right abutment, illustrates truly monolithic construction without longitudinal joints. Dam will be 440 ft high and will contain 2,400,000 cu yd of concrete.

This article was presented by Mr. Hardin at a Construction Division session presided over by A. H. Ayers, chairman of the Division's Executive Committee, at the Centennial Convention in Chicago.

Improved techniques lower cost of concrete construction

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Economies in concrete construction should be considered from two angles — economies that result in reductions in first cost, and economies that result in longer life and lowered maintenance because of superior initial quality. To secure economies of the latter type, a somewhat higher first cost may be required. But wise management and the exercise of forethought — two facets of economy as defined by Webster — dictate that low first cost should not be the only goal. It is sometimes necessary to draw a fine line when attempting to achieve a satisfactory balance between low first cost and quality. Nevertheless, it is for this balance that the engineer strives in his attempt to achieve the greatest economies in concrete construction today.

Remarkable progress has been made in the last twenty-five years toward greater economies in concrete construction. Economies in first cost, which in many instances can be closely estimated in dollars and cents, have been realized as a result of improved techniques in design, construction, and concrete technology. Probably more important, however, are the economies resulting from longer life and lower maintenance cost due to the application of these same techniques. These improvements have been most notable during the last eight to ten years, and further improvements are being made today.

Design for Monolithic Construction

One of the outstanding economies in the construction of large gravity type dams has resulted from an improvement in design to secure monolithic construction. As recently as ten years ago it was considered next to impossible to construct a gravity dam over 250 ft high without getting objectionable vertical cracking parallel to the axis. Undesirable and possibly dangerous cracking had occurred in dams lower than 250 ft. Cracking was caused by the large and non-uniform changes in concrete volume resulting from temperature changes due to the setting heat and subsequent cooling of the concrete. As a remedy, designers attempted to put "designed cracks" into the structure in the form of one or more longitudinal joints. With this design it was necessary to provide artificial cooling of the parts of each monolith to the "final" or "stable" temperature before the parts were joined together by grouting of the joints. Extensive embedded pipe systems for cooling water had to be installed, as well as a large grout pipe system with grout stops. The work of forming the joints, installing and operating the cooling systems, and installing the grout pipes and grouting the joints, all are expensive items. Also, because they are complicated and time consuming, these items place limitations on the scheduling and

execution of all the other construction operations.

Now, by virtue of new and proved techniques, it is no longer necessary to use longitudinal joints in large gravity dams. Instead the blocks or "monoliths" are constructed truly monolithic from the upstream to the downstream end. The volume changes accompanying temperature changes are controlled within safe limits by refrigeration of the materials to reduce the placing temperature of the concrete, use of cement having favorable heat generating characteristics, use of very low cement factors for the interior concrete, and regulation of the construction program to avoid construction situations conducive to cracking. Concrete placing temperatures in very large concrete dams are kept below 50 deg F; cement factors as low as 2 bags per cu yd are regularly used, and either moderate-heat or low-heat cement is used. The extremely low cement factors have been made possible by the use of entrained air in the concrete, and by proper and uniformly controlled aggregate grading.

On two large Corps of Engineers dams, each over 400 ft high, elimination of the longitudinal joints and the associated items of cooling and grouting have resulted in a saving of at least $2,000,000. These new techniques have successfully removed the danger of cracking; in fact, even minor cracking has been virtually eliminated. At the same time, important improvements in quality have resulted, with expected increased useful life and lower maintenance cost.

Economy Through Concrete Technology

Some very appreciable economies in concrete construction have been realized through advancements in concrete technology. The most important is the development of techniques for air entrainment. Entrainment of a small volume of air in concrete results in marked improvement in both its plastic and its hardened properties. Improvements in plastic properties, particularly placeability with a reduced water requirement, coupled with greater cohesiveness of the mix and reduced segregation, have made it possible to save large quantities of cement, to reduce placing costs, and to improve surface quality and appearance. The extremely low cement factors now being used in the interior of large mass concrete dams would not be possible without the use of entrained air.

On the two large dams previously referred to, it is estimated that an average of ½ bag of cement per cu yd of concrete has been saved by air entrainment, or nearly half a million barrels of cement. Similar savings in cement have been made on numerous other Corps of Engineers projects since entrained air was adopted for all Corps work about six years ago. In that period an estimated 2½ million barrels of cement have been saved by this practice, as well as several million dollars due to increased useful life and reduced maintenance.

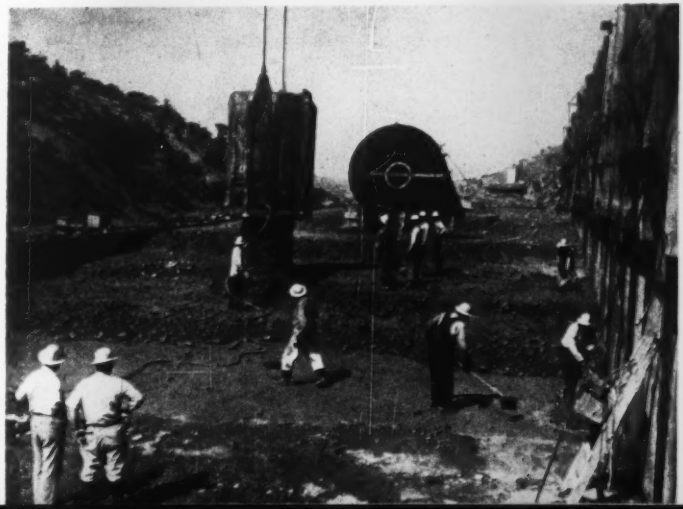
Entrained air vastly improves the quality of the hardened concrete, making its resistance to weathering and attack by agressive agents many times greater than that of non-air entrained concrete.

Another important improvement in concrete technology has been the development of new techniques for evaluating the quality of materials. The greatest strides have been made in evaluating the quality of aggregates. For many years arbitrary limits were placed on certain "pseudo" properties such as abrasion loss, sulfate loss, and deleterious substances. A paradox resulted in that aggregates of good quality were sometimes rejected, and vice versa. Also, because of the uncertainties involved, contractors were justifiably prone to add large contingencies to their bids.

Several years ago the Corps of Engineers adopted a procedure which has proved entirely satisfactory and has resulted in large economies. Under this procedure the best economically available aggregates for a project are selected and identified in advance of advertising the work. New laboratory techniques including accelerated freezing and thawing, petrographic examination, and tests for alkali aggregate reactivity, have been devised for determining relative quality of aggregates. The use of arbitrary limits on pseudo properties is no longer relied upon.

Investigations of aggregates for large concrete dams are started in the early planning stage, are carried to conclusion during the design stage, and culminate in the selection of one or more satisfactory sources which are named in the contract specifications. The investigation includes a thorough reconnaissance to locate potential sources, a complete laboratory evaluation to insure that the aggregate is of satisfactory quality, and a thorough prospecting of those sources that are satisfactory to establish that ample quantities are available. Also, processing tests are conducted on material from undeveloped sources to determine that the material can be successfully processed, and to establish the processing procedures. All information bearing on the cost of the work is made available to bidders.

As a result of this procedure, the uncertainties regarding aggregates which have plagued contractors and engineers alike in years past are largely eliminated, and contingencies to cover uncertainties are removed from the bidding. Aside from the fact



Dry concrete with low cement factor is being placed in Pine Flat Dam, where latest principles of concrete design are being followed, as well as most advanced methods of concrete placement. Note use of two-compartment, "regulated-discharge" bucket of 8-cu yd capacity without cableway "bounce", also small placing crew using heavy-duty vibrators.

that this is considered to be a sound engineering approach to the problem, the cost of all these investigations is only a small fraction of the contingencies which a contractor might otherwise be forced to include in his bid.

Evaluation of aggregates is only one part of the program by which laboratory investigations are utilized to effect economies in concrete construction. One of the more important aspects has been the development of substitute materials such as special cements and pozzolanic materials. Among the special cements, two—slag and natural cements—have been successfully used on several Corps of Engineers projects in which approximately 6 million cu yd of concrete were placed. An appreciable reduction in the cost of these projects was realized as well as other improvements.

While pozzolanic materials have not been used extensively in Corps of Engineers work, laboratory investigations now under way, and experience by others, indicate that large savings in first cost and improvements in concrete characteristics are possible through the use of such materials as "fly ash," treated shales, and natural pozzolans. Before such materials can be used they must be proved in the laboratory. The use of laboratories in the past has resulted in many economies in first cost; however, the greatest economies realized are in the quality of concrete construction.

Construction Plant and Practices

Notable advances have been made in the construction phase. The construction industry has demonstrated remarkable ingenuity in developing new plants to realize advancements made in concrete technology. Invariably when new and more strict requirements have been added in the specifications, there has been a negative reaction on the part of the "practical" construction man. His reaction is usually, "We can meet these requirements but it will increase the cost." In some instances this has been true, but it must be realized that the engineer has weighed this increased first cost against longer life and reduced maintenance cost in the finished structure. In many instances, however, requirements which in the beginning appeared to be destined to increase the first cost of the concrete have, in the long run, resulted in marked economies.

The requirements for grading and uniformity of fine aggregate have been tightened up in recent years, particularly in specifications for large mass concrete dams. Since the advent of air entrainment, specification limits on grading have been set to insure somewhat finer sand than was used in non-air-entrained concrete. In terms of fineness modulus, a sand within the range of 2.40 to 2.50 is now used as compared to 2.70 to 2.90 for non-air-entrained concrete. The amount of extreme fines—minus No. 100—which is now desired and required, is less, however, than usually was used in non-air-entrained concrete. In the matter of uniformity, the requirements are such that variations in grading expressed in terms of variation in fineness modulus are made very strict. These requirements are essential if the greatest benefits are to be derived from the use of entrained air. Without strict control of grading and uniformity of grading of fine aggregate it would not be possible even with air entrainment to consistently produce the extremely low-cement factor concrete which is essential to close control of volume change in large mass concrete dams.

To meet the requirements for grading and uniformity, a more careful approach has been necessary to the design of aggregate processing and handling plants. In the last 4 or 5 years contractors have designed, constructed, and operated successfully aggregate plants in which a high degree of flexibility and high rates of production have been the outstanding features. When the strict grading and uniformity requirements of the Corps of Engineers were first put into the specifications, contractors were prone to insist that the cost of aggregates would be excessively high. As experience has been gained, however, two important points have been demonstrated.

1. To produce a uniform aggregate, the rate of production must be uniform. The new plants can be operated at high uniform rates with a minimum of dependence on manual control. High rates of production have resulted in maximum utilization of equipment with a minimum of labor cost. Although difficult to estimate, real economies have resulted as reflected in recent trends in bid prices.

2. In the case of natural sand, new techniques are successfully producing sand with minimum waste. In several cases, the hydraulic sizer is being utilized, which can separate natural sand into as many as eight fractions. An excess in any size fraction can be stored for later use when a deficiency occurs in that size. Without the hydraulic sizer, it is necessary either to waste large quantities of poorly graded material or to use costly excess quantities of cement, since wide variations in grading are normal in natural aggregate deposits. The use of excess cement is intolerable on

Construction plant for Detroit Dam in Oregon is example of large modern installation. From upper left, proceeding to right and downward, are seen aggregate plant, cableway head towers, aggregate and cement cooling plant, cement storage silos, and mixing plant. Modern plants accomplish all operations relating to aggregate reclamation and delivery and cement storage and delivery with efficiency and greatly reduced manpower requirements.

large dams, where very lean interior mass concrete is an essential part of volume-change control.

In natural deposits where excesses in the coarse fractions are predominant, another technique is being successfully applied. Grinding equipment—usually a rod mill—is used in conjunction with the hydraulic sizer. The excess coarse material is ground in the rod mill and added to the sand to produce deficient fines. The same trends are evident in plants for the production of stone sand. Hydraulic sizers are being utilized, and the newest and most modern plants have also utilized the rod mill as the principal grinding equipment. Many of the recent plants utilize the "center periphery discharge" type of rod mill which, on the basis of experience, has a lower waste factor than the "overflow" type.

The question of whether first cost of fine aggregate meeting the stricter requirements has increased or decreased, may still be debatable; however, there is ample logic and growing evidence that the over-all cost has decreased. In any event the advantage of the minimum practical cement factor as a principal means of controlling volume change is ample justification for the rigid requirements, not to mention the improved quality of the structures produced.

Improved Batching and Mixing

Batching and mixing plants have also been improved in the past twenty years with resulting economies. The most notable improvements have been in large central mix plants such as are used for large gravity dams. Improvements have been made in accuracy, dependability, speed and efficiency.

For many years the view was held that batching and mixing of concrete could never be classed as a "manufacturing" process because of the lack of accuracy and efficiency. Twenty-five years ago, when materials were batched volumetrically, this view was justified. The mixing plants of that era could be identified by the ever-present cloud of cement dust which resulted from breaking of cement bags. Removal of cement from storage, transporting to the mixing plant, stacking into "batch-size" piles, and "busting" bags for a typical large mixing plant of that era required a large labor crew. Modern plants of the "automatic" or "fully automatic" type are capable of continuous high rates of production and accuracy in batching which are equivalent to that of some manufacturing processes.

Some of the plants of fifteen years ago, classified as "semi-automatic," required three men besides maintenance personnel. Two of these were "batcher" men and the third was the mixer dump man. In modern "automatic" or "fully automatic" plants, one man does the work, and production rates average vastly higher. All other operations related to batching and mixing, including reclaiming and delivery of aggregates to the mixing plant, and unloading, storage, and delivery of bulk cement, are also accomplished more efficiently and with greatly reduced manpower.

Notable advances in concrete placing methods include modern trestle plant, with both hammerhead and revolving cranes as used on Bull Shoals Dam in Arkansas. Dam is here seen under construction about a year before its completion in October 1951.

Advances in Transporting and Placing

Transporting and placing plant and methods have also been improved in the past twenty-five years, with consequent economies. As in the case of aggregate production and batching and mixing, many of the important improvements have been in the large plants. Two types of plants in general use twenty-five years ago for transporting and placing concrete were the "tower and chutes" and the "guy derrick." The tower-and-chute type of plant had one major fault: concrete mixes had to be designed to fit the characteristics of the plant rather than the requirements of the structure. In attempting to minimize the disastrous segregation that resulted from excessive handling, concrete technicians designed over-sanded mixes which required excessive cement. The high resulting cost of the concrete and the poor quality of the finished structures led to the abandonment of this type of plant.

The guy-derrick plant was a forerunner in many respects of the trestle-type plant of today. In this plant concrete was usually discharged into a bottom-dump bucket directly from the mixer, transferred to a pickup point on bucket cars and lifted into the forms by derrick. This plant embodied the basic principle of "least handling is best handling" and in that respect no fault could be found with it. Its principal faults were lack of mobility and lack of speed. Setting and resetting "guy derricks" was expensive and time consuming, and the coverage of each individual derrick was very limited.

Thirty years ago a plant was used at Wilson Dam which was similar in many respects to the present trestle plant. Terry cranes, similar in design and operation to the revolving cranes of today, were operated on track supported on piers which formed part of the dam. Concrete was delivered to the cranes in bottom-dump buckets on service trains. Basically the characteristics of this plant were satisfactory, but it could not compare in efficiency or speed with present-day trestle plants.

Two types of concrete-transporting and placing plants, with variations to suit job conditions, have come into general use today. In the cableway type plant, concrete is trans-

jected to the cableway hook from the mixing plant in bottom dump buckets on flat cars or by transfer car to a bottom dump bucket on the cableway hook for delivery to the forms. This type of plant has been in very successful use for many years, however, improvements have been made in its design in recent years which have greatly increased its speed and economy.

By comparison, one of two large cableways operating alone on a large project in the period 1945 to 1948, achieved a maximum sustained average rate of production of about 140 cu yd per hour, utilizing a 6-cu yd bucket. This rate was achieved with the second cableway idle. With both operating, the total rate was limited by the mixing plant capacity, which was about 150 cu yd per hour. On a large Corps of Engineers project now under way in California, a single high-speed cableway using an 8-cu yd bucket has achieved a sustained average rate of production in excess of 270 cu yd per hour.

The trestle type plant of today is extremely flexible and, because several placing rigs can be utilized on a single trestle, greater total rates of production can usually be achieved than with cableways under comparable circumstances. Generally, however, site conditions rather than production rate will decide the choice of plant. Whereas the cableway is more adaptable to the canyon type site, the trestle is more adaptable to wide river sites and low abutments.

Concrete for the trestle type of plant is delivered in bottom dump buckets on flat cars from the mixing plant to either revolving cranes or hammerhead cranes for delivery to the forms. Economies have largely been made by ingenious use of equipment. On most projects utilizing this type of plant in recent years, the bucket trains have required two men for operation—one dinkey operator and one bucket hooker. On one recently completed project, controls for operation of the dinkey were mounted on the bucket car, and one man performed both jobs.

Improvements in the design of bottom dump buckets, for transporting very dry, low cement factor, interior mass concrete for large dams have also been made in the past few years. The new buckets have made it possible to place such concrete efficiently. Their design is based largely on an investigation carried out by the Corps of Engineers in 1940 and 1947. This investigation involved design, construction, and field trials, and several manufacturers have designed buckets based on these tests.

One of the features of the new-type bucket is the "controllable dump," which has largely eliminated the great objection to the cableway as a concrete placing unit. The discharge of the "controllable dump" bucket is regulated either by opposing air cylinders or by a double acting air cylinder. With free discharge buckets, cableway "bounce" during dumping resulted in very objectionable segregation of dry concrete. The controllable dump bucket allows rapid discharge without segregation. Appreciable economies and improvements in quality have resulted.

Probably the most important development in equipment for concrete placing is the mechanical vibrator. In the opinion of many engineers, this development is second in importance only to air entrainment. The large placing crews with hip boots and spades, a familiar sight thirty or forty years ago, standing ankle deep in wet concrete, have given way to small crews equipped with powerful heavy duty internal vibrators. Placing rates, expressed as cubic yards per man hour or man day, have been increased many times since the internal vibrator came into use. Even more important, this vibrator has made possible the use of larger maximum size aggregate and the placing of very dry concrete. Both of these features have resulted in large economies in cement as well as improvements in quality.

Small-Job Equipment Developed

The improvements in transporting and placing equipment discussed thus far have largely related to high rate, large scale production. Equally important improvements have been made in equipment for smaller jobs. One of the most important of these is the positive displacement pump for transporting concrete by pipeline. This has contributed materially to economies in placing relatively small quantities of concrete distributed over a large area. This operation, which requires a minimum of manpower, has largely revolutionized certain types of building construction.

The familiar picture of a few years back was a maze of confusion. Large placing crews, spading and spreading the concrete; equally large crews constantly rearranging "duck boards," and scores of "Georgia buggies" moving to and from the mixer, have given way to the ultimate in orderliness. With a fraction of the manpower, the concrete is pumped in its final position through a pipe which is highly maneuverable. Reductions in first cost as well as remarkable improvement in quality of concrete have resulted. By virtue of a rare mechanical temperament, the pump will not successfully deliver an improperly designed mix, or concrete that varies in consistency over a wide range, or is segregated. It therefore serves as a first rate inspector.

Important economies in construction of concrete pavements have resulted from improvements in construction plant equipment and procedures. Efficient machine methods for compacting and trimming the subgrade have largely replaced the hand methods of past years. Heavier side forms, and auxiliary equipment for handling and setting forms, have conserved manpower and improved quality. Mixing plants have increased in size and efficiency until, with the largest new mixers, rates of production have been almost doubled over those of ten to fifteen years ago. Plants now in use can produce over 300 cu yd per hour for long periods.

Mechanical spreaders and mechanical floats have replaced hand methods with improved efficiency and quality. Recent designs have reduced expansion joints and improved the load carrying capacity of pavements. Air entrainment has also resulted in marked economies and improved quality. Surface scaling due to de-icing, non-skid treatments, and weathering, has been largely eliminated by the use of entrained air with the result that pavement life has been lengthened and maintenance materially reduced.

Many important economies have thus been made in recent years through improved techniques in concrete construction in spite of a friendly feud between the engineer on the one hand and the construction man on the other. Invariably, when the engineer adds new and more strict requirements in the specifications, the construction man accuses him of being an intolerable theorist who never gives cost proper consideration. Just as invariably, the engineer replies that the construction man has no appreciation of those engineering features that are necessary to assure quality in the finished structure, and can put only one value on a structure—first cost. Also, just as invariably, the two work together while appearing to be the bitterest of enemies, and the result has been, and will continue to be, improved techniques in design and construction decreasing first cost and adding quality, to the benefit of all concerned.

THE READERS WRITE

Laboratory Tests Recommended to Set Up Design Procedure for Steel Column Bases

• To the Editor: Two recent articles in CIVIL ENGINEERING, by Mr. Gitter in May and by Commander Brown in July, describe methods for design or analysis of steel column bases on concrete foundations when subjected to eccentric loading. This is a subject which apparently is avoided in our commonly used design codes. The AISC Design Manual provides only for the design of uniformly loaded bearing plates. Bearing stresses on concrete as given in the ACI Building Code, though not specifically so stated, apparently anticipate uniform bearing under the base plate. Apparently the problem is one of those for which the designer is expected to follow "recognized methods of design."

Both articles mentioned purport to analyze the distribution of stresses at a column base by using the equations for a reinforced concrete beam subject to both compression and bending. The dimensions of the base plate and the gross area of the anchor bolts are used in place of the dimensions of the concrete beam and the area of the reinforcing steel, from which point the method of development is identical with that followed for a reinforced concrete beam.

This approach fails to recognize several significant points of difference between the two cases. Of these the principal ones are:

1. The concrete pier, pedestal or base is generally larger than the steel base plate.

2. The steel base plate is less rigid than the concrete (as the "projection" past the face of the column is subject to bending).

3. The anchor bolt is commonly attached to the column at a point some distance above the base plate. This is shown in the sketches accompanying both articles.

4. The anchor bolts may be, and in all probability usually are, drawn up tight on installation to produce an initial stress in the bolts before any overturning moment is applied.

If these factors are considered in the analysis, the distribution of stresses will be considerably different from that given by the conventional formulas for reinforced concrete beams. Qualitatively the effect of each of these is as follows:

1. High bearing stresses in the concrete immediately below the base plate will be considerably reduced at a short depth below the surface as the load is spread out laterally until it is carried by the full section of the concrete, not just the portion below the steel base plate. Both articles recognize that the gross section of the anchor bolts, and not merely the root area at the threads, should be used in determining the elastic properties of the column base. The same line of reasoning would indicate that the concrete section to be used in the equations is greater than that immediately below the base plate. With a relatively high pier or pedestal only slightly larger than the base plate, the full concrete section could be used with little error, whereas with a large low pedestal the correct concrete area to use is intermediate between the two. If the base plate dimensions are used in the equations, the concrete is more rigid than indicated, and the equations should be corrected by reducing the value of n. This will reduce the value of k, shift the neutral axis farther from the anchor bolts which are in tension, increase the maximum stress in the concrete (though reducing the total compression), and reduce the tensile stress in the anchor bolts.

2. The steel base plate is most rigid at the point where the principal downward load is transmitted to it by the flange of the column, and to a lesser extent by the assembly of channels, angles or plates at the leeward anchor bolt. Any projection of the base plate past this point is subject to bending deflections increasing to the edge of the plate. These deflections decrease the strain in the concrete at the edge of the plate so that the distribution of stresses in the concrete is no longer triangular but follows a curve. If the base plate is very flexible, the maximum concrete stress may even occur some distance in from the edge. As the actual maximum stress will be less than that computed on the assumption of a straight line variation of stresses, a higher conventional design stress should be allowed with such an analysis.

3. This factor, alone, the attachment of the anchor bolts to the column at an appreciable distance above the base plate, can cause a significant error in the solution if it is ignored. The extra length in the anchor bolts increases the resilience or "stretch" of the steel for a given stress. This will have an effect similar to that of item 1 in shifting the neutral axis towards the leeward side, increasing the concrete stresses, and decreasing the tension in the anchor bolts. If the original equations are to be used, this factor can be allowed for by still further lowering the value of n to be used.

4. Initial tensioning of the anchor bolts has the effect of prestressing the connection. The neutral axis is shifted toward the windward or "tension side" of the section, the tensile stress in the anchor bolts is increased, the total compression in the concrete is increased, though the maximum concrete stress may or may not be increased. The initial tension in the bolts is the easiest of the factors mentioned to introduce into the equations as it is simply an internal force to be added both to the total tension in the steel and the total compression in the concrete. It might be noted, however, that with initial tensioning of the bolts it will be necessary to consider the action of the bolts on both the windward and the leeward sides of the column.

The above discussion would indicate that the equations derived for reinforced concrete beams cannot be used directly on the case at hand with the expectation of obtaining precise results, though the error may not be so great as to render them valueless.

Under some conditions the factors mentioned may tend to counteract each other to a certain extent. The writer would hesitate to advocate that the design equations be further complicated by the addition of more variables to allow for the secondary effects listed above, with dubious chances of achieving any substantial improvement in the results. It would appear that the most satisfactory solution to this case would be a series of laboratory tests to determine the relative importance of the different variables and to set up an empirical procedure to be followed in the design of a steel column base detail.

MARVIN A. LARSON, A.M.ASCE
Redwood City, Calif.

Effect of Key on Sliding of Retaining Wall

To the Editor: The article, "Sliding Stability of Retaining Walls," by Gordon P. Fisher and Robert M. Mains, both A.M.ASCE, which appeared in the July issue, was heartening as the majority of retaining wall failures today apparently are due to foundation difficulties.

Although in general agreement with the authors, I desire to point out that the sliding failure shown in Fig. 1, page 54, will not necessarily occur "with a simple separation along DJ," but that the rupture surface may continue horizontally from J to a point directly under E, in which case the active pressure should be continued to the bottom of the key. It may be of interest to note that the addition of a key may in some cases be shown to be detrimental, mathematically, to the sliding safety of a wall if computed in accordance with such a pressure pattern. This would indicate only that, assuming the computed active and passive pressures to be realistic, the keyed wall would tend to slide with a lower surface of rupture, carrying with it an inert block of foundation material. The wall would tend to slide in this way whether the key were added or not.

As the authors point out, the addition of a relatively shallow key, in general has little effect on the sliding resistance of a retaining wall; however, its use should be carefully considered when founding a wall on cohesive soil. A properly proportioned key, placed at or near the heel of the wall, will tend to insure that the rupture surface will remain within the foundation material, consequently developing the cohesive resistance of the soil.

JAMES D. WALL, J.M.ASCE
Structural Engineer
Corps of Engineers
Atlanta, Ga.

United States Slow to Realize Advantages of Prestressed Construction, European Authority States

To the Editor: In your August issue the article by Jacob Ehl, M. ASCE, Is Prestressing the Answer? is very disappointing. It contains many unstatements as well as such truisms as the statement that prestressed structures should not be built for the sake of their novelty, but only where they are technically better and more economical than conventional reinforced concrete.

By comparing the spiral staircase I built in Belgium (CIVIL ENGINEERING, for September 1951) with examples of so-called similar structures in reinforced concrete, the author shows that he has overlooked the importance of the spiral angle of the staircase and its width. The designer's difficulty increases with these two dimensions. One cannot compare toys with engineering works.

I wonder where in Belgium the author has seen curtain walls hanging from prestressed girders; nothing of this sort is to be found here.

What the author could have stated in an article bearing his title is that prestressed concrete is the answer to many engineering problems, as has been shown in Europe on a large scale during the past ten years. It is technically better and more economical than reinforced concrete as soon as the spans become longer than 30 ft. Also it makes possible the building of structures which could not be built of reinforced concrete.

That there still are such questions as creep and shrinkage to be cleared up, I quite agree, but does anyone believe that we know all there is to be known about steel structures? And does this prevent us from erecting them?

The United States, which is a most conservative country in the field of civil engineering, is bound to come to prestressed concrete on a large scale. This will happen when its engineers and contractors come to understand that if one can build a structure by using half the concrete and one fifth the steel required for reinforced concrete, one can afford to spend more on labor per unit volume of material. This idea has been slow to find acceptance in a country where labor is often saved up to the point of losing money and increasing the total cost of the structure.

How amazing it is for us Europeans to hear that even when the use of steel is restricted for civil use, steel is used instead of reinforced concrete, which would require only one tenth of the amount of steel and that sometimes reinforced concrete is used instead of prestressed concrete which would require only one fiftieth of the steel needed for the same structure built of steel. As a result, not only is there a great waste of steel, but also a very noticeable increase in the total cost.

One of the reasons for the rapid progress of prestressed concrete in Europe is the fact that we must save steel, and that the authorities here admit competitive designs. In the United States bids are generally asked on a complete design in which nothing can be altered by the contractor. At the same time, too few engineers who prepare the designs know enough about prestressing, and therefore avoid it.

These are the reasons why Europe has made such great advances in the field of prestressed concrete. Americans are capable of doing the same thing and even better, but they have been very slow in getting started.

G. MAGNEL, M. ASCE
Professor, University of Ghent
Ghent, Belgium

Project Developed by Salt River Valley Water Users Assn.

To the Editor: In an article by W. F. Uhl, M. ASCE, on page 151 of the September issue, there appears a picture of the Horse Mesa Dam and Powerhouse with the caption, "Horse Mesa Dam and Powerhouse on the Salt River, Arizona, were built by the U. S. Bureau of Reclamation in 1927."

The Horse Mesa Dam and Powerhouse were designed and constructed about 1927 by employees of the Salt River Valley Waters Users Association under my direction. At that time I was general manager and chief engineer of that Association.

In 1938, the Salt River Valley Water Users Association took over the operation of the Salt River project from the Bureau of Reclamation, and has operated and expanded the project with its own employees ever since that date.

C. C. CRAGIN, M. ASCE
El Paso Natural Gas Co.
El Paso, Texas

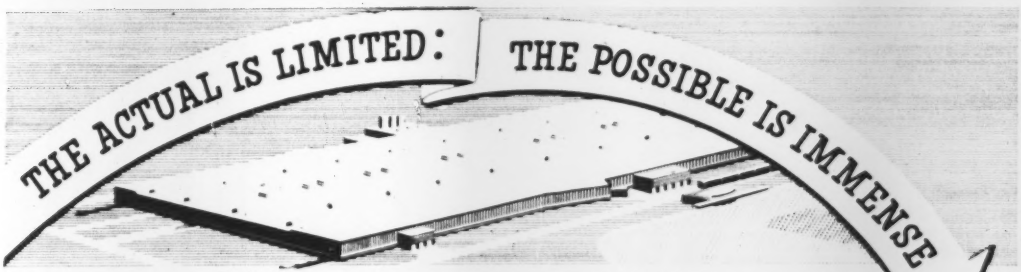
Charter Member Identified with Early Settlement of West

To the Editor: Since this is the Centennial year of our Society, I thought that you might be interested in the mention of one of the Charter Members, William D. Pickett, which I found in a book now out of print.

This book, *The Iron Trail*, is the reminiscence of Edward Gillette, M. ASCE. Mr. Gillette went out to Arizona in 1878 and spent the next twenty years locating railroads in the west and in Alaska. In 1891 he worked in the vicinity of Yellowstone Park, endeavoring to locate a new line across the Continental Divide. In his book he refers to Colonel Pickett as follows:

"At this time I received a letter from Colonel Pickett, who lived near the head of Grey Bull River, to the effect that as he was a Charter Member of the American Society of Civil Engineers he would expect me, as a member of that Society, to pay him a visit, on account of my being in the vicinity. It was a horseback trip of some sixty miles over a high mountain range with game trails the only routes for travel. The Colonel had filled an important place in the Southern Confederacy during the Civil War. Another Colonel Pickett, a relative, had achieved fame in what is known as 'Pickett's Charge' in the battle of Gettysburg. I called on the Colonel, a typical, aristocratic southern gentleman of the prewar period, who, after the Civil War, had settled in Wyoming, selecting the most remote location from civilization the country afforded. He could hardly have selected a more beautiful and wonderful place for scenery or game or for a cattle ranch. The Colonel was greatly interested in the development of the county and public affairs generally, but what impressed me more was his bear stories. In one year he had killed twenty-six bears, killing all but two with one shot. He considered shooting a bear twice as an evidence of poor skill. One evening he came upon four bears killing all of them. At a later period a post office was established at this place, named Fourbear."

ROBERT S. MAYO, M. ASCE
Mayo Tunnel and Mine
Lancaster, Pa.



NEW LINCOLN PLANT CREATED BY INCENTIVE-INSPIRED CO-ACTION IN DEVELOPING POSSIBILITIES IN PRODUCT

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WELDED DESIGN SIMPLIFIES CONSTRUCTION ...SPEEDS FABRICATION, CUTS ERECTION TIME

SHOWN below are typical examples of how welded design cuts building costs. Continuous framing and elimination of splice plates save substantial tonnage of steel. Efficient shop fabrication is achieved with fast, downhand welding techniques. Simple beam-to-column details speed field welding with resulting cost savings of 15% to 20%.

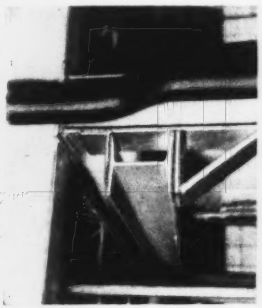


Fig 3 Simple design cuts cost 23% *on factory building. This half-rigid steel stud welded to beam required 70 man-hrs. on 70 days. Labor, welding and erection costs are $350 per connection compared to $50 for riveting. Contractors, Kepp & Mundt, Inc., Columbus, Ind.*

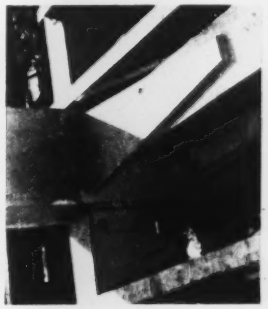
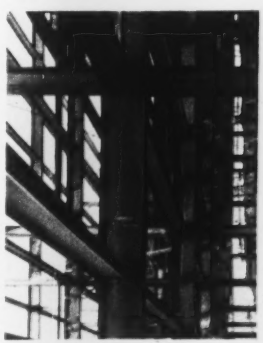


Fig 4. Continuous girder *passes over column and is spliced at point of minimum moment. Typical detail from multi-story 1700 ton framework that requires 15% less steel. Architect and designer, Paul H. Jeffers, California.*

Fig 5. Beam to column connection *on 11 story apartment. 1200 ton framework erected with 25% less steel. Field welds are made in fast, downhand position to cut erection time. Engineers and Contractors, Byrne Organization, Inc., Washington, D. C.*



WELDED DESIGN ALWAYS SAVES STEEL AND LOWERS COST

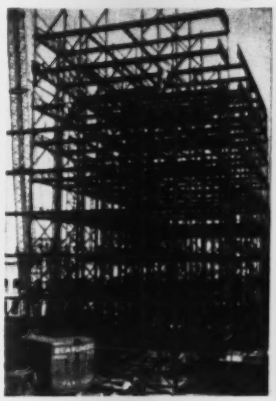


Fig. 1. Cuts steel 25% *on 13 story Ridpath Hotel, Spokane, Washington. Cost of all-welded design 900-ton framework is 20% less than riveting. Architect, Ned L. Abrams, Sunnyvale, California.*

Fig. 2. Steel tonnage is 15% less *on four story department store for J. W. Robinson Department Stores, Los Angeles, California. 6" less height per story results from welded design. Architects, Pereira and Luckman and Charles O. Matcham.*

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SOCIETY NEWS

Diverse San Francisco Convention Program Includes Post-Convention Trip to Hawaii

With the [illegible] Golden Section [illegible] the San Francisco Convention, to be held March 6-10, will mark the 43rd year of ASCE into its second century. Preparations are under the guidance of General Chairman L. A. Clarke and a post-convention trip to Hawaii has been arranged under the auspices of members of the Hawaii Section.

To accommodate the unusually full technical program, Technical Division events will start on Tuesday afternoon, March 5, continue Wednesday afternoon after the morning general session, and continue through the entire day on Friday, March 8. Thursday is reserved for excursions. Present planning is for two sessions each of the Air Transport Construction, Highway, Hydraulics, Irrigation, Power, Sanitary Engineering, Soil Mechanics & Foundations, and Structural Divisions. The Surveying and Mapping and Waterways Divisions will have one session each. Carl A. Dreyfus, chairman of the technical program, which will be printed in full in the January issue, [illegible] in the National Advisory Committee for Aeronautics. Construction of a new supersonic wind tunnel is under way there and will be at an interesting stage in March. The second trip will include visits to the new steam generating plants of the Pacific Gas & Electric Co. in Contra Costa County, across the bay from San Francisco on the south shore of tributary Suisun Bay. A new plant is being built at Pittsburg, and another plant at Antioch is being expanded to increase its capacity from 210,000 to 575,000 kw. The Pittsburg plant is of the open-air type with the turbine area exposed.

Two All Day Field Trips

A choice of two all-day field excursions has been arranged for Thursday. One of the trips to the Ames Aeronautical Laboratory at Moffett Field is sponsored

Interesting Ladies Entertainment

Entertainment for the ladies will include trips on the San Francisco peninsula and in particular, a visit to the McClellan Nurseries. The nurseries specialty is gardenias which it supplies to the cut flowers industry in great quantity. Orchid culture is another interesting feature of the McClellan operation. During the trip there will be a luncheon at the Lake Merced Country Club. Other plans of the committee on ladies entertainment are not complete, though it is known that Wednesday, March 7, will be kept open for shopping and sightseeing. A staff of hostesses will be on hand at the Fairmont Hotel headquarters throughout the week to give assistance to delegates' wives in planning their activities.

Wednesday is reserved for the principal social event of the Convention, a dinner-dance at the Fairmont Hotel. Both the Gold and Nob Hill rooms of the hotel will be taken over for the occasion, which will be formal. Semi-formal dress will be acceptable as an encouragement to attendance by those who spend their lives in khaki.

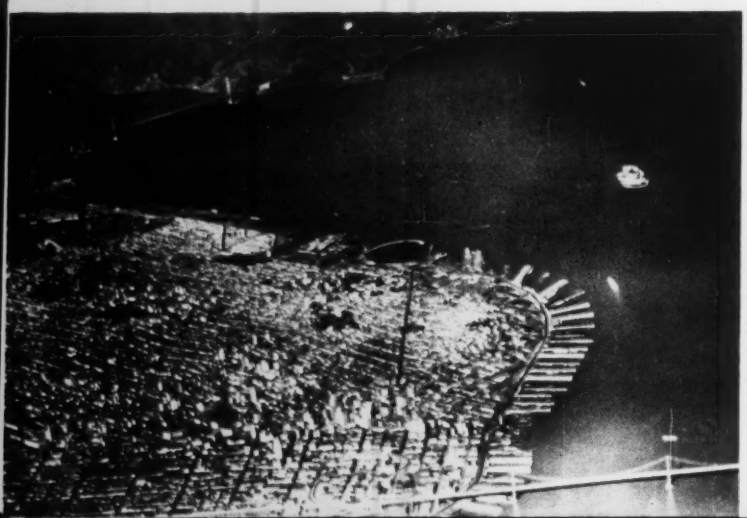
Early Registration Requested

Hotel reservations for the Convention are being handled by the ASCE Housing Bureau, which will make available detailed information and reservation forms in a later issue. At the three hotels in which blocks of rooms have been reserved, the Fairmont, Mark Hopkins, and Huntington, prices for single rooms range from $6 to $15. Double and twin-bed rooms are priced between $8 and $18, while parlor suites cost from $15 to $40, all on a daily basis. William W. Moore, chairman of the hotels and registration committee for the Convention, emphasizes that single rooms will be scarce and suggests that single delegates plan to share rooms.

Post-Convention Tour to Hawaii

The post-convention tour to Honolulu and the Hawaiian Islands will convene officially in Honolulu on March 9. Since there will be no convenient sailings to meet that date, air travel will be necessary for delegates and their families making the trip. Reservations for travel and hotels should be arranged through George B. Smith, representative of the International Travel Service at 210 Post Street, San Francisco 8, Calif. A deposit of $50 will be required with each completed reservation.

Round trip rate by either Pan American World Airways or United Airlines is $288 plus 15 percent tax. The air trip takes between 9 and 10 hours, with daily service in Boeing Stratocruisers offered by



Aerial view of famous Gold Coast area of San Francisco shows Golden Gate Bridge in background, and San Francisco–Oakland Bay Bridge in foreground. Unique among United States cities, San Francisco will provide interesting and beautiful Convention background. Photo courtesy San Francisco Convention and Tourist Bureau.

both airlines. Society members wishing to compromise in their mode of travel and return to the mainland by ship will be able to leave Honolulu by the "Lurline" on March 21, arriving in San Francisco five days later, on March 26. One way fare is $145 and up, plus 15 percent tax.

Members making the trip will be met upon arrival in Honolulu with the Islands' traditional "aloha" ceremonies, including leis and hula dancers supplied by the Hawaii Visitors Bureau. Representatives of the Hawaii Section will be at the airport, too.

Registration is scheduled for March 9 in Honolulu. March 10 will be given over to a business meeting of the Hawaii Section, with Robert Belt, president of the Section and general chairman of the post convention tour, presiding. Further sessions on March 11 will be followed by a field trip and luau, or banquet, with the Section as host.

In addition to the fabled scenic and seismic features of the Island, ASCE members will be attracted by many engineering achievements, notably the Naval facilities at Pearl Harbor. Clearance of the harbor's channels and locks following the assault of December 1941 still stands as a major engineering project of World War II. Subterranean fuel oil storage vaults and antenna towers for unprecedented long range radio transmission are other major engineering accomplishments.

Honolulu is located on the Island of Oahu. Tours may be made to the other islands of the group, such as Hawaii, Maui and Kauai. A circular giving full details of these trips is obtainable from Mr. George R. Smith, 210 Post Street, San Francisco 8, Calif.

Robert M. Belt, president of Hawaii Section, and Robert Chuck, J.M. ASCE, discuss plans for further development of famed Waikiki Beach, which last year was widened by addition of 110,000 cu yd of sand. Present plans of Territorial Department of Public Works call for still further improvement of Waikiki.

President Huber Gives Inaugural Address at Metropolitan Section Dinner Meeting

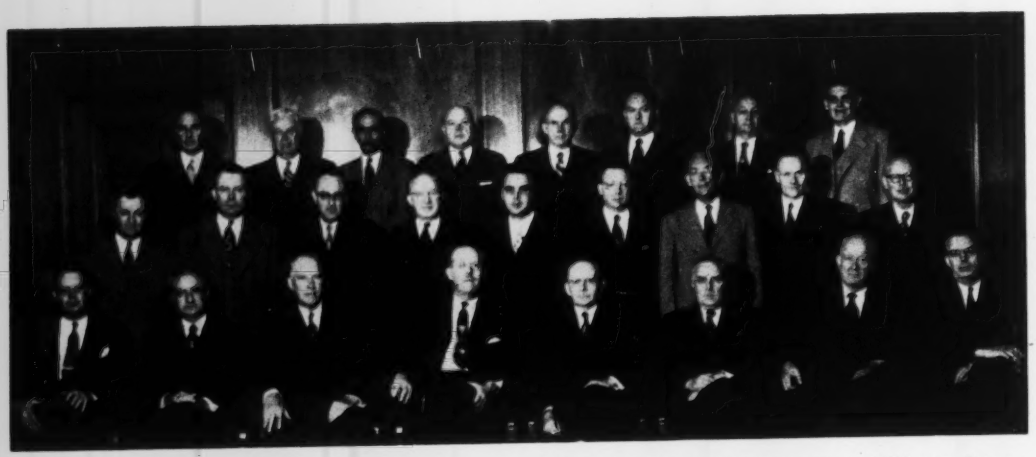
Following his induction into the presidency of ASCE, which took place at the Society's annual business meeting in New York on October 15, Walter L. Huber delivered his inaugural address at a dinner meeting of the Metropolitan Section held at the Statler Hotel. In his talk, entitled "A Second Century of Service Begins," Mr. Huber said that the definition of engineering as the "task of directing the sources of power in Nature to the use and convenience of man," is applicable throughout the ages. "We start the second century," he said, "with the same general task as that which faced our founding fathers but with very different conditions and necessarily with a different outlook." His address setting forth the changed conditions and new outlook is printed elsewhere in the issue.

Another interesting feature of the dinner meeting, which was attended by about 250, was the presentation of the Leon S. Moisseiff Award to Mario G. Salvadori, A.M. ASCE, associate professor of civil engineering at Columbia University, for his paper on "Numerical Computations of Buckling Loads by Finite Differences" in Volume 116 of TRANSACTIONS. When the other ASCE prizes were presented during the Centennial Convocation in Chicago, Professor Salvadori was in Istanbul, Turkey, representing ASCE at the International Congress of Theoretical and Applied Mechanics.

In his acceptance speech, Professor Salvadori noted that both he, an Italian, and Dr. Moisseiff, a Russian, had come to the United States, in different periods, to escape intellectual oppression in their home countries, and expressed his gratitude for the opportunity of working in a free environment. L.R. Howson, chairman of the Committee on Publications, made the presentation.

The newly elected Chancellor of New York University, Henry T. Heald, M. ASCE, spoke briefly and amusingly, drawing parallels and pointing contrasts between the presidency of a great university and the presidency of the Society.

ASCE President Walter L. Huber presents traditional gavel to his predecessor in office, Carlton S. Proctor, following his induction as President during Society's annual business meeting in New York on October 15.



Incoming Board of Direction is photographed at ASCE Headquarters in New York on October 15. In front row, are G. Brooks Earnest, Vice-President, Zone III; Edmund Friedman, Vice-President, Zone II; George W. Burpee, Vice-President, Zone I; Carlton S. Proctor, Past-President; Walter L. Huber, President; Gail A. Hathaway, Past-President; A. M. Rawn, Vice-President, Zone IV; Wm. N. Carey, Executive Secretary. Second row shows Lloyd D. Knapp, Director, District 7; Burton G. Dwyre, Director, District 15; Glenn W. Holcomb, Director, District 12; Francis S. Friel, Director, District 4; Merrell J. Shelton, Director, District 11; Wallace L. Chadwick, Director, District 11; Frank A. Marston, Director, District 2; Warren W. Parks, Director, District 9; and Francis M. Dawson, Director, District 16. In third row are Walter D. Binger, Director, District 1; Louis R. Howson, Director, District 8; A. A. K. Booth, Director, District 3; Kirby Smith, Director District 1; James A. Higgs, Director, District 10; Norman R. Moore, Director, District 14; Carl G. Paulsen, Director, District 5; George W. McAlpin, Director, District 6. Not shown in photograph are Charles B. Molineaux, Director, District 1; Charles E. Trout, Treasurer; and I. C. Steele, Director, District 11.

Actions of ASCE Board of Direction Briefed

Actions taken by the Board of Direction at its meetings at Society Headquarters in New York, October 13 and 14, 1952, are summarized in the following paragraphs:

Local Section Conference Authorized

On recommendation of the Committee on Local Sections, the Board approved the holding of a Local Section Conference during the San Francisco Convention in March 1953, and appropriated funds to finance mileage for one delegate from each of the following Sections: Alaska, Columbia, Hawaii, Los Angeles, Oregon, Sacramento, San Diego, San Francisco, Seattle, Spokane, and Tacoma.

Technical Procedure Improved

On recommendation of the Technical Procedure Committee, the Board encouraged the Technical Divisions to include in their sessions subjects of current concern to the profession even though they may be controversial. The Board also voted funds for continuation of the practice of preprinting Division papers and making them available for sale to their authors and to other members in advance of the Convention where they are to be presented.

Budget Balanced

A balanced operating budget of $911,000 was approved, based on anticipated income of an equal amount.

Toward Unity of Engineering Profession

As a constituent member of Engineers Joint Council, the Board of Direction gave its approval on behalf of ASCE to amending the constitution of EJC to permit its enlargement by inviting other societies to become members.

Appointments

Appointments to Committees of the Board of Direction, to Auxiliary Administrative Committees, and to Professional Technical and Task Committees of the Society are named on another page of this department.

Faculty Advisers to Meet

Authorization was given for the holding of a Conference of Faculty Advisers of Student Chapters in San Francisco during the Convention in March 1953, and the Board appropriated funds to finance the necessary mileage.

Junior Members

On recommendation of the Committee on Juniors, the Board has suggested to Local Sections and Technical Divisions that they take further steps to utilize the capabilities of qualified Junior Members in their respective activities.

Centennial Volume of Transactions

Approval was given to a recommendation of the Publications Committee that an additional volume of TRANSACTIONS be published in 1953 to include those Chicago Centennial Convocation papers having Centennial significance.

Newsletter Initiated By Alaska Section

With issuance of a monthly newsletter, the recently established Alaska Section joins the growing ranks of Sections sponsoring publications of one sort or another. Of special value because of the vast extent of the Alaska Section, the mimeographed news sheet will spotlight ASCE affairs of special interest and provide pertinent data on meetings of the various Sub-Sections and on non-ASCE meetings of engineering interest.

The Alaska Section, which was established last year, brings to 73 the list of ASCE Sections.

ASCE Elects Eleven New Officers for 1953

In the third ASCE election since adoption of the new Constitution, the Society has elected a President, two Vice-Presidents, and eight Directors. The results of the balloting were announced in the October issue (page 790). Some of the new officers were inducted at the Society's annual business meeting, held in New York on October 15. The rest will take office in January.

A biographical sketch of Walter L. Huber, newly elected President of the Society and San Francisco consultant, appeared in the May issue, following his nomination for the presidency. Brief biographical sketches of the other new officers follow.

Edmund Friedman

A consulting engineer in general practice, Edmund Friedman, Vice-President for Zone II, is vice-president of the firm of Maurice H. Connell & Associates, Inc., of Miami, Fla.

Mr. Friedman, a native of Nashville, Tenn., graduated summa cum laude from Vanderbilt University in 1918, with the degree of bachelor of engineering. Shortly after graduation he enlisted in the Army for service in World War I. After his discharge from the Army he was engaged for several years in various phases of civil engineering, principally in private practice. In 1925, while assistant city engineer of Jackson, Miss., he accepted an appointment as city engineer of Coral Gables, Fla., serving in that capacity until 1929, when he became city manager of Coral Gables. His term of office was distinguished by an economical and efficient administration.

Appointed county engineer of Dade County, Florida, in 1932, Mr. Friedman soon developed an outstanding department and, at the same time, increased the scope of his work to include many activities not usually associated with such an office. As county engineer, he was largely responsible for the conception, planning, and development of the county's highway, zoning, and park systems, Rickenbacker Causeway, mosquito control, water control and conservation, and the planning of many other important county projects.

In 1942, Mr. Friedman was commissioned in the Engineer Corps of the Army, and served for three and a half years. During his army service, he participated in the construction of most of the military and air bases in Florida, and was also assigned for a year to the headquarters of the Army Service Forces. Placed on inactive status in December 1945, Mr. Friedman resumed engineering practice as vice-president of the firm of Maurice H. Connell & Associates. This firm, which was engaged in general engineering, was architect-engineer on government work totaling $50,000,000. Its recent assignments have included two veterans' hospitals, a $2,500,000 refuse incinerator for the City of Miami, and

EDMUND FRIEDMAN
Vice-President, Zone II

G. BROOKS EARNEST
Vice-President, Zone III

utility improvements at Florida State College and Florida A. & M. College.

Since his election to ASCE membership in 1927, Mr. Friedman has been active in Society and Local Section affairs. He has served the Miami Section as secretary and twice as president. He recently completed a three-year term as Director for District 10.

Long interested in the social and economic advancement of the engineer, Mr. Friedman has also played a prominent part in the activities of other technical and professional groups. He has been president of the Florida Engineering Society; vice-president of the Southern District of the American Road Builders Association; secretary of the Florida chapter of the Institute of Traffic Engineers; and president of the Florida State Board of Engineering Examiners.

G. Brooks Earnest

G. Brooks Earnest, newly elected Vice-President for Zone III, has just been elected president of Penn College in Cleveland.

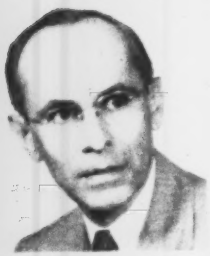
A two-year intermission between his sophomore and junior years at Case School of Applied Science (now Case Institute of Technology) was spent with the American Steel and Wire Co., the Republic Structural Iron Co., and as research assistant with the late Dr. Dayton C. Miller, prominent physicist. Following Mr. Earnest's graduation from Case in 1927 with a B.S. degree in civil engineering, he worked with the Pennsylvania State Highway Department and several railroads.

Returning to Case in 1930 as an instructor in civil engineering, Mr. Earnest obtained his M.S. degree in civil engineering in 1933, became assistant professor in 1935, associate professor in 1942, and professor of engineering surveying in 1948. In 1951 he went to Penn College as dean of engineering, and for the past eight months has been acting president. He will be formally inducted into the presidency next spring. Since 1937 he has been associate director and (1944) consulting director on the Cleveland Regional Geodetic Survey. He organized the first large-scale city mapping program using photogrammetric procedures.

During World War II, in addition to his teaching duties, Professor Earnest was executive secretary to the President of Case, assisting in developing the Navy V-12 program and as faculty adviser to several student organizations. He has given freely of his time and abilities to civic and allied activities. He was on the Mayor's Committee on City Planning, which recommended the existing City Planning Department setup for Cleveland, and on the Advisory Committee to the Cleveland Transit Board, which made recommendations pertaining to the rapid transit program now in force. He is a member of the Cleveland Automobile Club Transportation, Transit and Traffic Panel and the Transportation Committee for the Cleveland Heights Chamber of Commerce.

In addition to the ASCE, Professor Earnest holds membership in the American Congress on Surveying and Mapping, the American Society of Photogrammetry, the American Society of Engineering Education (chairman, Committee on Surveying and Mapping, 1943) the Society of American Military Engineers, the Cleveland Engineering Society, and the American Association of University Professors. He is a registered pro-

CHARLES B. MOLINEAUX
District, District 1



A. A. K. BOOTH
Director, District 3

CARL G. PAULSEN
Director, District 5

LLOYD D. KNAPP
Director, District 7

...engineer and director in the ... and a member of the Educa... a committee of the Ohio Society of ... and Engineers, and the Constitu... and By-Laws Committee of the ... Society of Professional Engi... He is a past president (1946) ... of the Cleveland Technical Society ... Council, and has been chairman of its ... Program Committee and the Public ... Affairs Committee and a member of the ... Board of Governors through 1948.

Professor Earnest was elected an Associate Member of ASCE in 1926 and ... in 1940. He served as secre... treasurer of the Cleveland Section ... 1935 to 1937, vice-president in ... 1938, and director from 1939 to ... He was ... director from 1943 to 1945. He has ... served ASCE activities include membership on the Executive Committee, the ... Division of Surveying and Mapping, ... 1950, chairman, 1951, and the ... Committee on Student Chapters, 1951 ... 1952, chairman, 1952. He is now ... planning a three-year term as Director ... for District 6.

Professor Earnest is the author of a ... number of articles, including one in the ... Civil Engineering Geodetic survey control ... and aerial mapping project, which has ... appeared in CIVIL ENGINEERING, Photo... Engineering, Surveying and Mapping, ... and the Journal of the Surveying Divi... He is co-author of specifications for Topo... graphic Surveys, which appeared in ... Photogrammetric Manual.

Charles B. Molineaux

As construction expert, Charles B. Molineaux, new Society Director for District 1, is currently general manager of construction of the Ford Motor Company's new automobile assembly plant at Edgewater, N. J. Previously, he was in charge of construction for the Ford Motor Company at its Dearborn, Mich., plant. Mr. Molineaux's early activities were with New York utility and transportation companies on construction of plant. Since 1923 he has been successively engineer and chief engineer and vice-president of The Arthur A. Johnson Corp., a New York contracting firm which has done a large volume of construction work in the Northeastern States and Canada. He has collaborated with other engineers and contractors on joint ventures and has in this capacity been associated with the Mason & Hanger Co., Inc., Nacirio Co., Inc., B. Perini & Sons, Inc., and others.

Mr. Molineaux has contributed several articles to CIVIL ENGINEERING and was author of papers presented at ASCE Conventions in Mexico City and Toronto. He has been president of the Metropolitan Section of ASCE and of the New York State Society of Professional Engineers.

A. A. K. Booth

A civil engineer graduate of Cornell University with the master of manufacturing engineering degree from Rensselaer Polytechnic Institute, A. A. K. Booth, new Director for District 3, is currently the associate head of the Evening and Extension Division of Rensselaer at Troy, N. Y.

Starting his professional life with the American Bridge Company, Professor Booth later served as engineer for the Stone & Webster Engineering Corp. and structural engineer for the Duke Power Co. In 1942 he joined the University of Connecticut faculty as assistant professor of civil engineering but returned to industry the following year to direct the Engineering Training Program and develop the Engineering Aide Program for Pratt & Whitney Aircraft. In 1945 he accepted an invitation to join the faculty of the Army University Program and served for a year as professor of civil engineering and lecturer in England, France, and Germany. He has been on the faculty at Rensselaer since 1949.

Joining ASCE as a Junior Member in 1927, Professor Booth became a Member in 1941. He has served the Society as vice-president of the North Carolina Section and secretary and president of the Mohawk-Hudson Section. He is president of the Rensselaer Chapter of the New York State Society of Professional Engineers and a member of the American Society for Engineering Education and the American Water Works Association.

Carl G. Paulsen

The newly elected Director for District 5, Carl G. Paulsen, is an outstanding authority on water resources investigations. Since 1946 he has been chief hydraulic engineer of the United States Geological Survey, Water Resources Division, Washington, D.C. Before becoming chief of the Water Resources Division, his responsibilities were assistant chief hydraulic engineer, 1940-1945; chief of the Surface Water Branch, 1931-1939; district hydraulic engineer of Idaho, 1939-1941; and district hydraulic engineer of the Southeastern States with headquarters at Atlanta, Ga., 1918-1939. He has published numerous reports on hydrology and hydrologic projects in the United States, Alaska, and Puerto Rico.

Mr. Paulsen is an alumnus of the University of Idaho, having received his B.S.C.E. degree in 1915. During World War I he was attached to the 30th Engineers, 91st Division, and in 1918 detailed on special war emergency assignments in the Southeastern States, primarily in connection with activities of the War Industries Board and the United States Fuel Administration.

Mr. Paulsen became an Associate Member of the Society in 1918 and a Member in 1927. He was president of the District of Columbia Section in 1947, and has filled numerous committee assignments on different occasions.

Lloyd D. Knapp

Several important posts on the City of Milwaukee engineering staff have been held by Lloyd D. Knapp, ASCE Director

for District 7. A civil engineering graduate of the University of Illinois, class of 1915, Mr. Knapp had early experience on drainage projects in western Minnesota and on railroad construction and maintenance in Tennessee. In 1916, after two years in the 104th Engineers Regiment, with 16½ months' service in France in World War I, he became terminal engineer for the Texas & Pacific and Missouri Pacific Terminal Railroad of New Orleans on maintenance and minor construction.

In 1925 Mr. Knapp went to Milwaukee as an engineer in the Bureau of Engineers, holding this position until 1926 when he was appointed engineer in charge of grade crossing elimination and other special projects. He was promoted to the position of superintendent of the Bureau of Sewers in 1945, and in 1950 assumed his present post as city engineer. His work as city engineer involves supervising the functions of the Bureau of Engineers, handling engineering studies, such as that of the recently completed sewer service charges, and supervising the entire water system.

Long interested in the Society, Mr. Knapp became an Associate Member of the ASCE in 1928, and a Member in 1943. From 1943 to 1946 he served on the Committee on Local Sections, and was elected chairman of the committee for 1946. From 1938 to 1942 he was secretary-treasurer for the Wisconsin Section and in 1946 president. Since 1946 he has been Contact Member between the Marquette University Student Chapter and the Wisconsin Section.

In addition to his activities in the ASCE, Mr. Knapp has been an active member of the WSPE, NSPE, American Water Works Association, American Public Works Association, American Society for Public Administration, and the Central States Sewage and Industrial Wastes Association. He has been active in the Engineers Society of Milwaukee since he joined in 1945, and was a director of that organization from 1947 to 1949.

Warren W. Parks

Warren W. Parks, now Director for District 9, is manager of the Village of Indian Hill, Ohio. A civil engineering graduate of Worcester Polytechnic Institute, class of 1917, Mr. Parks had early experience in surveying work in Pennsylvania and Massachusetts. From 1920 to 1924 he was with Eaton, Spofford and Thorndike, Boston consultants, as field engineer in connection with the construction of the Hampden County Memorial Bridge over the Connecticut River at Springfield, and resident engineer on construction of Maremont, near Cincinnati, called "a national exemplar in town planning." From 1924 to 1931 he was engineer for the Maremont Co. organized to complete construction of and to operate the Town of Maremont. He was chief engineer for the Thomas J. Emery Memorial, successor to the Maremont Co., from 1933 to 1943, and since the latter year has been manager of the Village of Indian Hill (an 18.5 sq. mile area with 42 miles of roads and 55 miles of water mains).

As secretary of the Indian Hill Village Planning Commission, Mr. Parks has helped prepare its zoning ordinance, subdivision regulations, and building code. He has also contributed professional reports and articles on construction projects to various technical publications.

Mr. Parks' professional society affiliations are numerous. He became an Associate Member of ASCE in 1922 and Member in 1932, and has been president of the Cincinnati Section. He is a past president of the Cincinnati Section of the American Association of Engineers, former director of the Engineering Society of Cincinnati, and past president of the Technical and Scientific Societies Council of Cincinnati, made up of 24 local chapters of national societies and the Engineering Society of Cincinnati. He is district director of the Ohio Municipal League and has been active in the American Society of Planning Officials, the American Water Works Association, and the American Public Works Association.

Marcel J. Shelton

Marcel J. Shelton, now Director for District 11, is general manager and chief engineer of La Mesa, Lemon Grove and Spring Valley Irrigation District, near San Diego, Calif. He is a graduate of Purdue University, receiving the B.S.C.E. degree in 1926. His early experience includes four years as civil engineer for the Indiana & Michigan Electric Company and three and a half years as a reserve officer on active duty with the CCC in the Western States. In 1936, Mr. Shelton established a private civil engineering practice in San Diego. He served a year and a half as planning and operations engineer for the WPA, San Diego area, and was city engineer for El Centro, Calif., during reconstruction of the city after the 1940 earthquake.

Called to active duty with the Corps of Engineers early in 1942, Mr. Shelton served on airport construction in the United States and Brazil until November 1945. He then became associated with the La Mesa, Lemon Grove and Spring Valley Irrigation District as construction engineer. He has been general manager and chief engineer since 1948. Prominently identified with water activities, he is director and secretary of the San Diego County Water Authority, director and chairman of the San Diego Regional Water Pollution Control Board, director of the San Diego County Weather Corporation (cloud seeding program), chairman of the Water Supply Division, California, AWWA, and of the 1951 Water Conservation Program in San Diego County, and member of the executive committee of the California Section, AWWA, and of the California Irrigation Districts Association.

Mr. Shelton became an Associate Member of ASCE in 1942 and Member in 1947. His Society activities include the general chairmanship of the Fifth Annual Conference of California Sections, and the presidency of the San Diego Section.

WARREN W. PARKS
Director, District 9

MERCEL J. SHELTON
Director, District 11

GLENN W. HOLCOMB
Director, District 12

FRANCIS M. DAWSON
Director, District 16

Glenn W. Holcomb

Well known as an engineering educator, Glenn W. Holcomb, ASCE Director for District 12, is professor of structural engineering at Oregon State College, Corvallis. A civil engineering graduate of the University of Michigan in 1939, he received his M.S. in education from Oregon State College in 1951. In 1941 and 1942 he was in the Engineers Reserve, U.S. Army, serving for most of this period as instructor in surveying at the University of Michigan under direction of the Army. During summer vacations he has engaged in such projects as directing and writing Civil Service examinations for the engineering division of the City of Portland, making a salary survey for the Oregon State Engineers' Employees Association, and work for private consultants.

On the staff of Oregon State College since 1939, he has been promoted through the various positions from instructor in civil engineering to full professor. Professor Holcomb's work at Oregon State has included teaching extension courses for Army Engineers and other adult groups. At present he is completing research on stress distribution in top chord splices of the Arch Deck Truss. He is author of various engineering manuals published by the OSC Cooperative Book Store and of engineering personnel and aptitude studies published in the *Journal of Applied Psychology* and in the Journal of the Society for the Promotion of Engineering Education (now the ASEE).

Becoming an Associate Member of ASCE in 1938 and Member in 1951, Professor Holcomb has been active in the Oregon Section, which he served as vice-president in 1951 and 1952 and president in 1952 and 1953. His numerous affiliations include the American Society for Engineering Education, in which he has been secretary and vice-chairman of the Northwest Section and chairman of the Structural Committee. He is a member of the Corvallis Water Commission, the Corvallis City Council, and other municipal and civic groups.

Francis M. Dawson

Francis M. Dawson, newly elected Director for District 10, has had a long and distinguished career as an engineering educator. Since 1946 he has been dean of the College of Engineering and professor of engineering at the State University of Iowa. A naturalized citizen and long-time resident of the United States, Dean Dawson was born in Nova Scotia. He graduated in civil engineering from the Nova Scotia Technical College at Halifax in 1910, and three years later received the M.C.E. degree from Cornell University. His military service in World War I included more than four years of active duty, primarily with the Canadian 8th Engineer Battalion as captain and adjutant. In the years just before and after the war he was engaged on general construction projects.

Dean Dawson began his teaching career in 1921 as an assistant professor at Cornell University, becoming professor of hydraulics at the University of Kansas in 1922, professor of hydraulic and sanitary engineering at the University of Wisconsin in 1928, and dean of engineering at the State University of Iowa in 1936. His Schoder-Dawson book on *Hydraulics* has been a standard text for many years, and Dean Dawson is also author of the hydraulics section in O'Rourke's *General Engineering Handbook* and of numerous technical papers.

He has been active in some ten professional societies, in many of which he has held important offices, including the presidency of the Central States Sewage Works Association in 1948, of the Iowa Engineering Society in 1940, and of the Engineering College Research Association from 1946 to 1948. When the American Society for Engineering Education was reorganized, he was elected vice-president in charge of the Engineering College Research Council and in 1951 served as president of the society proper.

For his contributions to the American Standards Association, Dean Dawson has received one of the four certificates it has so far given for distinguished service. He has also served the National Resources Planning Board, the Engineers Council for Professional Development, the Army Specialized Training Program, the Iowa Water Planning Committee, and the Iowa Natural Resources Council. He is now chairman of Selections Board for Engineers, National Research Council. Early this year, he accepted a Fulbright appointment to lecture for several months in hydraulic engineering in Pakistan.

Dean Dawson's interest in ASCE is evidenced by the fact that he has attended all but one Annual Meeting since 1927, the year he became a Member.

Centennial Featured at West Virginia Section Meeting

The ASCE Centennial was highlighted at the annual meeting of the West Virginia Section, held in Charleston, W. Va., October 3 and 4. On September 29, the Society's commemorative stamp was first issued in Charleston, with appropriate ceremonies at the post office. The annual meeting program consisted of a technical session on Friday afternoon, a banquet on Friday evening, and a business session on Saturday morning.

Speakers on the technical program included R. N. Shepard, engineer of construction and design, Carbide & Carbon Chemical Corp., Charleston, who gave a report on the Centennial Convocation in Chicago; J. E. Settle, Charleston consultant, who discussed the city's sewage treatment plans; and Elmer K. Timby, partner in the New York firm of Howard Needles, Tammen & Bergendoff, whose subject was "Engineering Features of the West Virginia Turnpike."

New officers elected during the business meeting are K. A. Kettle, president; Fred R. Palmer, first vice-president; R. E. Baker, second vice-president; and James F. Allen, secretary-treasurer.

Pictured at recent annual meeting of West Virginia Section are (front row, left to right) Ray Cavendish, executive director, West Virginia Turnpike Commission; K. A. Kettle, president-elect of Section; and Elmer K. Timby, New York consultant and speaker on technical program. In back row are J. E. Settle and R. N. Shepard, Charleston engineers who spoke during technical session, and G. W. McAlpin, ASCE Director, District 6.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

NPA Controls on Construction

To permit preliminary planning for future construction and the placing of advance orders, NPA has announced some prospective relaxations in its regulations, which are scheduled to become effective May 1, 1953, with the probability of an earlier effective date if conditions permit. The proposed changes are stated in a new Direction 8 to CMP Reg 6 dated October 3, 1952, which will include the lifting of the ban on recreational building. The new Direction 8 increases the amount of structural steel that can be self-authorized for highways from 2 to 12 tons per project. It also increases the amounts of steel that may be self-authorized for residential construction. The amount for certain other types of construction, including "commercial, school and hospital, water, sewage, public utility and transportation projects, will be increased from 5 to 25 tons of steel per project.

Other changes effective immediately include a new CMP Reg. 6, together with several amended directions to this regulation. This incorporates provisions of Order M-100, the housing order, which is revoked.

Construction Projects

The key to shortages of construction materials once again is steel. Except for the strike, it is likely that the production from expanded facilities would have permitted decontrolling steel with the exception of a very few special items. Heavy sheared plates and wide-flange structural shapes and beams are scarce.

Steel allotments for the first quarter of 1953 have been authorized to the various NPA claimant agencies. Of a total of 715,000 tons authorized, the Department of Defense gets 185,000 tons, the Bureau of Public Roads 114,000, the Atomic Energy Commission 87,000, the Defense Electric Power Administration 90,000, and the Petroleum Administration for Defense 60,000. The amounts represent an increase to the first three agencies named over the allotments for the previous quarters. Supplies of copper and aluminum are expected to be sufficient to meet all civilian needs by the end of 1952.

Despite these shortages, 1952 seems to be heading for a record construction volume of $32 billion, $1 billion greater than 1951.

With gigantic military and atomic energy programs in full swing, 1953 gives promise of being another banner year for construction. Eased credit restrictions plus intensive selling efforts are counted on to insure a high volume of residential building. Construction of commercial buildings, schools, hospitals and highways will undoubtedly be at improved levels. Building costs, now at an all-time high, appear to be stabilizing for the next year.

Salary Stabilization Board

The Salary Stabilization Board has established eight regional offices to handle its work in the field. These offices are located in Atlanta, Boston, Chicago, Cleveland, Denver, New York, Philadelphia and San Francisco (see "News Briefs" item for addresses). It has also made an arrangement with the Wage Stabilization Board to make available regulations, interpretations, and other information through the 35 offices of this latter Board. In general, questions of interpretation must be handled through one of the regional offices or through the headquarters of the Office of Salary Stabilization in Washington.

One question which has been asked of this office is whether an engineer must be licensed to be considered a professional engineer. At least one office of the Board tentatively took an affirmative position on this question. However, it is now clear that registration is simply one of several methods of establishing the fact that a person is qualified as a professional engineer, and it has little bearing on the question of whether he is engaged in a professional capacity. As a matter of fact, the requirement that exemptions apply only to registered engineers was eliminated from the bill through the efforts of ASCE. Far less than half of the country's engineers are registered and only a very small proportion of those are required to be registered. ASCE, although a pioneer in promoting and a strong supporter of registration, took the position that it would be highly confusing and discriminatory to include the requirement of registration as the sole basis for exemption. It discussed that matter with the Congressional Committee in its successful efforts to secure the enactment of the legislation.

ASCE MEMBERSHIP AS OF OCTOBER 9, 1952

Members	8,229
Associate Members	10,474
Junior Members	16,428
Affiliates	66
Honorary Members	42
Total	35,099
(October 9, 1951	35,176)

Contract Renegotiation

The Renegotiation Board has established six regional boards to handle the renegotiation of contracts. They are located in New York, Chicago, Los Angeles, Detroit, Boston and Washington. Construction contracts for engineering and architectural services will be handled only by the New York, Chicago and Los Angeles Regional Boards. The New York Board will handle cases from the Washington, Boston and New York regions. The Chicago Board will handle both the Chicago and Detroit regions. Reports will continue to be filed with the headquarters board in the District of Columbia, which will assign them to the three Regional Boards.

Engineers holding contracts that are subject to renegotiation must report on a "Standard Form of Contractors Reports" before the first day of the fourth calendar month following the close of their fiscal year.

No construction or engineer-architect contracts have yet come up for renegotiation. In cases involving profits of more than $400,000, the regional boards will in general make recommendations only. Although contracts with the Corps of Engineers and the Bureau of Reclamation are subject to renegotiation, all contracts on reclamation jobs and on *civil works* jobs of the Corps of Engineers will be exempt except those entered into after June 30, 1950, which relate directly or indirectly to electric power generation and distribution.

Government Publications Available

A new edition of the *Handbook of Emergency Defense Activities*, a directory of federal agencies related to the defense program, may be obtained from the Superintendent of Documents, Washington 25, D.C., for 30 cents. A 34-page pamphlet, *Interim Guide for Design of Buildings Exposed to Atomic Blasts*, describing the effects of explosions and methods of strengthening buildings, is obtainable for 15 cents. The much discussed Paley report, *Resources for Freedom*, is available in five volumes. Volume I, which is the basic report, may be obtained for $1.25.

Washington, D.C.
October 17, 1952

Spokane Engineers Celebrate ASCE Centennial of Engineering

Engineers of Spokane and the Inland Empire of Eastern Washington and Northern Idaho joined in a week long celebration of one hundred years of engineering progress September 30 through October 4—sponsored by the Spokane Section of ASCE. The observance was maintained on a strictly all-engineering plane throughout and local groups of the other Founder Societies participated equally in planning and carrying out the week's activities.

The guiding principle of the week was that the general public should share in the anniversary celebration and be made aware of the role of engineering in furthering industrial progress and a strong national economy. To this end the regular weekly meetings of the principal Spokane civic groups were dedicated to the engineering Centennial theme and outstanding speakers were engaged for the Spokane Chamber of Commerce, the Retail Credit Association, the Rotary Club and other similar groups.

Of particular interest were the programs presented to the schools. Programs were planned for grades five to twelve and 29 schools were visited. Here, squads of two engineers explained the engineering profession and the opportunities for high school students in each school's area. Following the talk a moving picture was shown on some phase of engineering. More than 6,500 students attended these conversations and in general displayed keen interest in the programs. A four hour continuous showing of engineering moving pictures on Saturday afternoon was also well attended.

For the engineers themselves, the weekend of October 3-4 was the focal point of the celebration. A technical symposium on Friday night featured talks by three outstanding authorities in their respective fields. Paul Travis, manager of public relations for Morrison Knudsen Co. Inc., presented an illustrated talk on the part played by the general contractor in promoting Inter American relations. Dr. W. Patmore, of the General Electric Co. Hanford Wash., spoke on "Engineering, Education and Entropy," and Arthur Hemenway, of the Boeing Aircraft Co. Seattle explained "The Role of Engineering in Aviation." Culmination of the week was the Engineers' Centennial Banquet and Dance held Saturday night in the Spokane Hotel.

The Centennial observance commanded wide radio and press coverage, including a five page engineering supplement in the *Spokesman-Review*. The Section reports that the program was a success in making engineers conscious of their greater role in the world, in promoting friendly relations among local sections of the Founder Societies, and in particular, in presenting the engineering profession and its achievements to the public.

W. A. Hill, past president of the Spokane Section, headed the Engineers' Centennial Committee.

Members of Centennial Committee in charge of Spokane celebration are (seated, left to right) H. C. Martindale, D. S. Angell, F. R. Morral, and I. R. Thomas, Jr. Standing, in same order, are W. E. Stephens, W. K. Stockdale, W. A. Hill, L. K. Smith, and D. L. Meyers. Photo courtesy "Spokesman-Review."

Manual on Cylindrical Concrete Shell Roofs

The thirty-first in the list of ASCE Manuals of Engineering Practice, entitled "Design of Cylindrical Concrete Shell Roofs," is an outstanding example of cooperative committee effort. In preparation since 1946, this Manual serves to make shell design available to structural designers, who wish to avoid the mathematical complexities involved in this branch of structural analysis. With the help of Manual 31, particularly its tables of coefficients, design constants and typical expressions, the arduous task of analyzing shells has been reduced, relatively, from a question of days to a matter of hours.

About 200 pages in length, the paper-bound manual is organized under seven major headings: History of Shell Design Theories, Design Procedure, Design Example (long shells, simply supported), Design Example (long shells, continuous over supports), Design of Transverse Stiffness, Effect of Continuity of Shell and Transverse Stiffener, and Elastic Stability of Shells. Three appendixes present details of the theory, a schedule of suggested standard notation, and a list of 117 reading references. There are 40 illustrations, photographs and line drawings, and 27 tables of design guidance data, occupying roughly 46 pages.

Preparation and printing of Manual 31 have been made possible by close cooperation between the Portland Cement Association and the Society. The selling price is $5, with a 50 percent discount available to ASCE members. Instructions for ordering this and other Society Manuals are given on page 98.

IAHR to Meet with ASCE Hydraulics Division

Progress in planning for the plenary meeting of the International Association for Hydraulic Research and the ASCE Hydraulics Division, to be held at the University of Minnesota at Minneapolis, August 31-September 4, 1953, is announced by Lorenz G. Straub, M. ASCE, president of the IAHR. Technical meetings of the Section of Hydrology of the American Geophysical Union and the Council on Wave Research will be held immediately before and after the IAHR meetings.

Subject matter for the IAHR-ASCE

joint technical sessions will be limited to:

1. Density Currents
2. Air Entrainment by Flowing Water
3. Waves, Beach Erosion, and Hydromechanics of Shore Structures
4. Basic Relationships of Sediment Transportation by Flowing Water

All authors are expected to present papers in person at the meeting. In the case of members outside continental North America, exceptionally meritorious papers on the four authorized topics may be presented by alternates.

Titles of papers should be submitted to Dr. Straub at the St. Anthony Falls Hydraulic Laboratory, Minneapolis 14, Minn., not later than November 30. Manuscripts to be considered for the program and for publication should reach him not later than March 1, 1953.

Board Confirms 1952–1953 Committee Personnel

The Board of Direction, at its meetings in New York in October, confirmed appointment of ASCE committees for the coming year. The committees of the Board are as follows:

Executive Committee: W. L. Huber, Chairman; G. W. Burpee, Vice Chairman; C. S. Proctor; G. A. Hathaway; A. M. Rawn; Edmund Friedman; and G. B. Earnest.

Honorary Membership: W. L. Huber, Chairman; G. W. Burpee, Vice Chairman; C. S. Proctor; G. A. Hathaway; A. M. Rawn; Edmund Friedman; and G. B. Earnest.

Districts and Zones: G. W. Burpee, Chairman; A. M. Rawn; Edmund Friedman; and G. B. Earnest.

Professional Conduct: W. L. Chadwick, Chairman; W. D. Bunger; J. A. Higgs; F. A. Marston; and F. M. Dawson.

Publications: L. R. Howson, Chairman; F. A. Marston, Vice Chairman; F. S. Friel; N. R. Moore; J. C. Steele; and G. W. Holcomb.

Membership Qualifications: B. G. Dwyre, Chairman; W. D. Bunger, Vice Chairman; W. L. Chadwick; G. W. McAlpin; M. J. Shelton; and C. G. Paulsen.

Division Activities: G. W. Burpee, Chairman; Edmund Friedman, Vice Chairman; L. R. Howson, ex officio; Kirby Smith; A. A. K. Booth; and Shortridge Hardesty, ex officio.

Meetings: G. W. Burpee, Chairman; A. M. Rawn, Vice Chairman; Edmund Friedman; and G. B. Earnest.

Coordination of Professional Activities: N. R. Moore, Chairman (Local Sections); W. L. Chadwick (Junior Members); J. A. Higgs (Student Chapters); J. C. Steele (Empl. Conditions); W. W. Parks (Salaries); C. B. Molineaux (Registration); L. D. Knapp (Prof. Practice); and F. M. Dawson (Eng. Education).

The Auxiliary Administrative Committees will be:

Local Sections: John A. Focht, Chairman (Oct. 1956); Ray L. Derby (Oct. 1954); Craig P. Hazelet (Oct. 1955); Wm. S. LaLonde, Jr. (Oct. 1956); and Norman R. Moore, Contact Member (Oct. 1953).

Junior Members: Archie N. Carter, Chairman (Oct. 1953); T. A. W. Binford, Vice Chairman (Oct. 1954); George H. Lacy (Oct. 1955); Jewell M. Garrelts (Oct. 1956); and W. L. Chadwick, Contact Member (Oct. 1953).

Student Chapters: Robert H. Dodds, Chairman (Oct. 1953); George W. Bradshaw (Oct. 1954); Leo C. Novak (Oct. 1955); C. D. Williams (Oct. 1956); C. R. Dole (Oct. 1957); and J. A. Higgs, Contact Member (Oct. 1953).

Application Classification: Albert Haertlein, Chairman (Oct. 1956); Wm. M. Griffin (Oct. 1953); Wm. J. Shea (Oct. 1954); L. G. Holleran (Oct. 1955); and W. D. Bunger, Contact Member (Oct. 1953). Alternates: Harold L. Blakeslee (Oct. 1953) and Van T. Boughton (Oct. 1954).

Securities (All Oct. 1953): Ralph R. Rumery, Chairman; F. M. Van Norden; Geo. W. Burpee; and Walter D. Bunger.

Budget (All Oct. 1953): George W. Burpee, Chairman; F. A. Marston; and S. T. Harding.

Annual Meeting: Kirby Smith, Contact Member (Oct. 1953).

National Affairs (All Oct. 1953): Francis S. Friel, Chairman; Ernest E. Howard; Charles E. Smith; and Walter D. Bunger.

Retirement: Walter D. Bunger, Contact Member (Oct. 1953); C. E. Beam, Secretary (Oct. 1953); and Wm. J. Shea, Treasurer (Oct. 1953).

The new Professional Committees are:

Engineering Education: Weston S. Evans, Sr., Chairman (Oct. 1953); A. A. Jakkula (Oct. 1954); Philip C. Rutledge (Oct. 1955); H. A. Williams (Oct. 1956); and F. M. Dawson, Contact Member (Oct. 1953).

Registration: Clarence L. Eckel, Chairman (Oct. 1953); G. A. Bolden, Vice Chairman (Oct. 1954); F. L. Castleman, Jr. (Oct. 1955); H. E. Wessman (Oct. 1956); and C. B. Molineaux, Contact Member (Oct. 1953).

Professional Practice: G. J. Requardt, Chairman (Oct. 1953); Herbert C. Gee, Vice Chairman (Oct. 1954); N. T. Veatch (Oct. 1955); Ralph A. Tudor (Oct. 1956); and L. D. Knapp, Contact Member (Oct. 1953).

Salaries: Ray F. Lawrence, Chairman (Oct. 1953); H. E. McGee, Vice Chairman (Oct. 1954); Robert J. Ellison (Oct. 1955); Carroll A. Farwell (Oct. 1956); and W. W. Parks, Contact Member (Oct. 1953).

Employment Conditions: G. J. Feutel, Chairman (Oct. 1953); J. J. Ballard, Vice Chairman (Oct. 1954); C. W. Yoder (Oct. 1955); Manno C. Backlund (Oct. 1956); Sterling S. Green (Oct. 1955); P. M. Wentworth (Oct. 1955); and J. C. Steele, Contact Member (Oct. 1953).

Appointees to the Technical Committees are as follows:

Technical Procedure (all Oct. 1953): George W. Burpee, Chairman; Edmund Friedman, Vice Chairman; Kirby Smith; A. A. K. Booth; Shortridge Hardesty,* ex officio; and L. R. Howson† (ex officio). In addition, the committee includes the chairman of the executive committee of each Technical Division.

Research: Shortridge Hardesty, Chairman (Oct. 1953); H. B. Gotaas, Vice Chairman (Oct. 1954); Elmer K. Timby (Oct. 1955); Robert E. Blanks (Oct. 1956); and F. M. Dawson, Contact Member (Oct. 1953).

Papers: L. R. Howson, Chairman; Donald M. Baker; Edward J. Cleary; Linton E. Grinter; and George H. Hickox. (This is a Task Committee, a Subcommittee of the Committee on Technical Procedure. Terms are for the duration of the task.)

New appointments to the Task Committees follow. All terms expire in October 1953 unless otherwise indicated.

Advisory Committee on U.S. Water Policy Panel: L. R. Howson, Chairman; W. L. Chadwick, Vice Chairman; Norman R. Moore; J. C. Steele; George W. McAlpin; and M. J. Shelton.

Awards and Ceremonies: L. R. Howson, Chairman; Burton G. Dwyre; C. B. Molineaux; A. A. K. Booth; and Warren W. Parks.

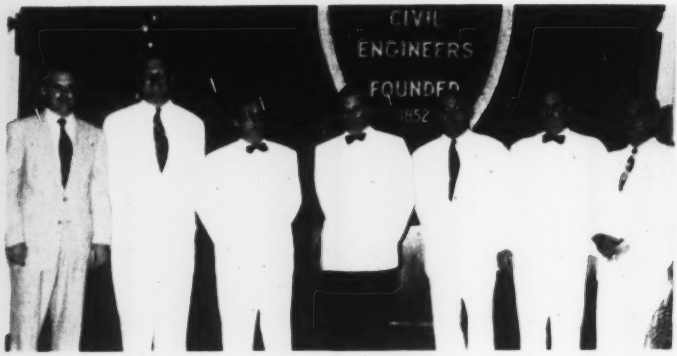
George Washington Canal and Locks: A. P. Greensfelder, Chairman; Daniel C. Walser; U. S. Grant, 3rd; F. J. Weaver; and C. G. Paulsen, Contact Member.

Study of Expanding Society Services: G. W. Burpee, Chairman; F. S. Friel; and W. G. Bowman.

Defense Design: W. L. Huber, Chairman; C. S. Proctor; G. A. Hathaway; G. W. Burpee; and W. N. Carey.

Study of Technical Division Structure: Jewell M. Garrelts, Chairman; Frank A. Marston; Philip C. Rutledge; George R.

* Chairman, Research Committee.
† Chairman, Publications Committee.



Officials attending Panama Section's centennial celebration includes (left to right) L. W. Cagley, secretary-treasurer of Section; D. L. Hartwell, first vice-president; Cesar A. Guillen; Gov. John S. Seybold; Ignacio Molino, Jr.; Section President H. E. Clare, Jr.; and Guillermo Rodriguez.

Panama Section Honors Society's Centennial

To commemorate the Society's Centennial, the Panama Section held a gala dinner meeting at the Tivoli Hotel in Balboa Heights, with John S. Seybold, M. ASCE, governor of the Panama Canal, the guest speaker and Ernesto Jaen Guardia, first president of the Section and ex-president of the Republic of Panama, acting as master of ceremonies. As another phase of its centennial celebration, the Section sponsored a series of visits to graduating high school classes to explain the significance and importance of the engineering profession.

In his review of the past century of engineering progress, Governor Seybold touched on the problems confronting the engineer scientist of today and his role in government and society. He stressed the need for teamwork in our production efforts. "The problem of the West in its struggle for survival," he said, "involves a coordinated plan for strengthening the productive agencies, designing and developing equipment of maximum combat strength to continually improve our standard of living and maintain our foremost position in the economy of our community. This involves the utilization of our material resources, the improvement of our social relationships with bodies politic and with individuals, and it involves the complete and skillful utilization of our manpower."

Coming Events

Alabama Winter meeting at the Jefferson Davis Hotel, Montgomery, Ala., on December 5 and 6.

Arizona Annual meeting in Phoenix, Ariz., on November 29.

Central Ohio Annual meeting featuring installation of new officers and ladies night on December 4.

Cleveland Joint meeting with construction division of the Cleveland Engineering Society in the auditorium of the Cleveland Engineering Society, on November 17, at 8 p.m. There will be a dinner at 6:30 p.m.

Florida Annual meeting and celebration of the Centennial at Tampa, December 5 and 6. Registration, Friday; forum on Tampa Bay Bridge, Friday afternoon, and cocktail party and annual banquet, Friday evening. Inspection trip on Saturday.

Intermountain Special meeting to discuss engineering registration law at the Union Building, University of Utah, on November 13. Annual business meeting will be held on December 4.

Iowa Annual meeting at Hotel Fort Des Moines, Des Moines, on November 20; afternoon session at 2 p.m.; and evening session at 6:30 p.m.

Kansas Meeting with Kansas State Student Chapter at Manhattan, on November 14.

Kansas City Dinner meeting at the Wishbone Restaurant, on November 11, at 6:30 p.m. Annual meeting on December 9.

Los Angeles Regular meetings are held on the second of each month, at the Alexandria Hotel, Los Angeles, at 6:30 p.m. Sanitary Group will meet at Hotel Clark on December 3, at 6 p.m. Soil Mechanics Group will meet at Hotel Clark on November 19, at 6:30 p.m. Weekly Friday luncheon meetings of the Junior Forum, at the Hotel Clark Coffee Shop, 12 noon.

Maryland—Dinner meeting at the Engineers Club of Baltimore, on November 12, at 7 p.m., preceded by cocktail hour at 6 p.m.

Metropolitan Section—Dinner meeting of the Junior Branch at Schwartz's Restaurant, 52 Broad St., on November 12.

Mid-South—Annual meeting at the King Cotton Hotel, Memphis, Tenn., on November 6 and 7.

Nebraska—Annual joint meeting with University of Nebraska Student Chapter, at Lincoln, on November 19. Annual meeting at Omaha, on December 9.

Northeastern—Dinner meeting at Boston Yacht Club, Boston, Mass., November 24.

Northwestern—Annual meeting and ladies' night at the Curtis Hotel, Minneapolis, Minn., December 1, at 6:30 p.m.

Philadelphia—Meeting at the Engineers' Club on November 11. Meetings of the Junior Forum are held on the fourth Tuesday of each month, excepting December and March. Central Pennsylvania Sub-Section will meet at State College, Pa., on November 12.

Providence—Meetings are held on the second Thursday of each month at 8 p.m., Providence Engineering Society auditorium.

Oklahoma—Annual meeting at Stillwater, Okla., on November 20.

Southern Idaho—Meeting at the Idaho Power Co. auditorium, Boise, Idaho, on November 14, at 8 p.m.

St. Louis—Annual dinner meeting at the Sheraton Hotel, St. Louis, Mo., on December 5, at 7 p.m. Election of officers for 1953 will be held.

Tacoma—Meeting at the Little Church of the Prairie, Lakewood, Wash., November 11.

Tennessee Valley Section—Annual fall meeting at the Hotel Patten, in Chattanooga, Tenn., on November 7 and 8. Business session, Friday morning; technical session, Friday afternoon; dinner and dance, Friday evening; and inspection trip and barbecue on Saturday. Holston Sub-Section meeting at the Franklin Club, Elizabethton, on November 18, at 6:30 p.m.

West Virginia—Dinner meeting at the Hotel Fredrick in Huntington on November 14. Program will consist of forum on the new Tri State Airport and Approaches, preceded by afternoon inspection trip.

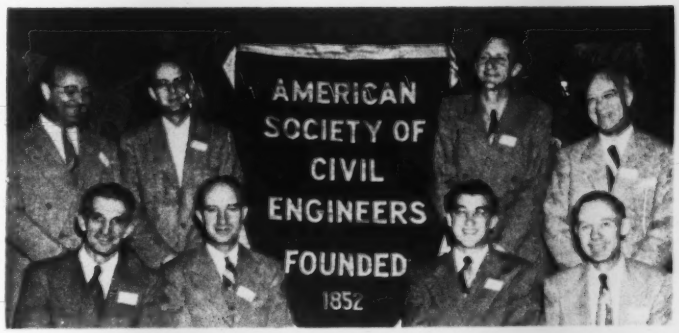
INTER-AMERICAN CONVENTION
San Juan, Puerto Rico, November 12–15

Scheduled ASCE Conventions

SAN FRANCISCO CONVENTION
Fairmont Hotel
March 2–7
1953

MIAMI BEACH CONVENTION
Casa Blanca Hotel
June 17–19
1953

NEW YORK CONVENTION
Hotel Statler
October 19–23
1953



New and old officers of Montana Section are photographed at Billings, Mont., during the Section's two-day annual meeting held early in October. New officers (seated left to right) are: Frank Stermitz of Helena, vice-president; Joseph A. Maierle of Helena, president; D. H. Park of Helena, secretary-treasurer; and O. C. Reedy of Billings, vice-president. G. J. Hoge, of Great Falls, and A. J. Johannesen, of Hungry Horse, are the vice-presidents not pictured. Outoing officers (standing in same order) are: William P. Price, Jr., of Helena, A. A. Van Teylingen of Great Falls, William J. Wenzel of Great Falls, and Henry G. Groves of Billings. Principal business discussed was a movement to bring about changes in the state's Engineer Registration Law, with Dean E. W. Schilling, head of the Engineering School at Montana State College, a principal speaker.

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Buffalo	September 15	73	Carlton S. Proctor, ASCE President, reported on the significance of the Centennial Convocation.
Central Ohio	September 18	27	Inspection trip to Pollak Steel Co., Marion, Ohio. David Pollak, of the steel company, answered questions on operations of the plant at a dinner meeting following the trip.
Cincinnati	October 1	55	Walter C. Beckjord, president, and Leonard V. Smoot, senior engineer, Cincinnati Gas and Electric Co., presented a talk on "The Planning, Financing, Design, and Construction of the Walter C. Beckjord Turbo-Generating Station."
Connecticut	October 20	58	Dinner meeting. Guest speakers included Walter L. Huber, newly-installed President of ASCE, who spoke on Local Section activities, and Clifford S. Strike, president and treasurer, F. H. McGraw & Co., who talked about the Paducah, Ky., Atomic Energy project his company is building for the AEC.
Florida Jacksonville Sub-Section	September 30	21	J. G. Stokes, structural engineer, Portland Cement Association, gave a talk on and demonstration of prestressed beams.
Intermountain	September 4	29	Richard L. Sloane, associate professor of civil engineering, University of Utah, acted as chairman for a program on salaries and fees.
	October 2	41	Two Section members—Glenn Enke, Utah Construction Co., Salt Lake City, and George Poulsen, consulting engineer of the same city—were the speakers.
Kansas City	September 17	134	Dinner meeting. Robert W. Long, Long Construction Co., discussed the relationship of the contractor to the engineering profession. John Newell, chief engineer, Massman Construction Co., Kansas City, Mo., talked on a paper he presented at the recent Centennial Convocation.

Los Angeles	October 8	[illegible]	An illustrated talk on "The Big Creek 4 Power Project" was delivered by P. B. Perrooks, assistant manager of engineering, Southern California Edison Co.
Maryland	October 9	[illegible]	Dinner meeting. C. A. Vincent, naval architect, Newport News Shipbuilding and Dry Dock Co., Newport News, Va., spoke on forces acting on the hull of a ship and demonstrated with a film on the *S.S. United States*.
Mid-South	September 19	[illegible]	Summer meeting. Hon. Pratt Remmell, mayor of Little Rock, Ark., presented address of welcome. Guy W. Cobb, drainage consultant, Arkansas State Highway Department, Joseph B. Anderson, biologist, U. S. Public Health Service, and N. J. Law, district engineer, American Institute of Steel Construction, were guest speakers. Decision was made to appoint a committee of *Junior* members to advise on activities of interest to Juniors in Section.
Nebraska	October 17	[illegible]	Dinner meeting addressed by H. J. Gibbs, earth materials research engineer, Bureau of Reclamation Laboratory, Denver, Colo. Mr. Gibbs spoke on "Research Studies in Loess for Determination of Behavior of Pile."
Northwestern	October 6	[illegible]	A talk entitled "Safer Highways Are Being Built. How to Get More of Them," was presented by Archie Carter, manager of the Highway Contractors Division of the AGC, at dinner meeting.
Philadelphia Central Pennsylvania Sub-Section	September 24	[illegible]	Dinner meeting. Prof. Louis Berger, of Pennsylvania State College, discussed a rational approach to footing design, and T. Robert Keadey, of Modjeski and Masters, read a paper entitled "Story of a Bridge Pier."
Pittsburgh	September 22	[illegible]	Inspection tour of the Penn Lincoln Parkway West.
Providence	October 9	[illegible]	An illustrated talk was given by Mr. Collins, superintendent of filtration, Water Supply Board, Providence, R. I., on the introduction of fluorides to the city's water supply.
St. Louis	September 22	[illegible]	Latest developments in the aircraft industry were discussed by Don R. Berlin, vice president and general manager of McDonnell Aircraft Corp.
Tacoma	September 9	[illegible]	Past president of the Section, Fred M. Veatch, district engineer, water resources division, U. S. Geological Survey delivered a talk on the program and activities of the Survey.
Tennessee Valley Chattanooga Sub-Section	September 24	[illegible]	Newly elected officers for 1953 include Llewellyn Evans, president, and Nathan S. Dougherty, secretary. Mr. Dougherty and John W. Pierson, consulting engineer of Chattanooga, described construction of the McCallie Avenue tunnel.
Holston Sub-Section	September 24	[illegible]	Henry Dougherty, Portland Cement Association, Memphis, Tenn., and Oscar E. King, Portland Cement Association, Knoxville, Tenn., spoke on prestressed concrete.
Texas Dallas Branch	September 8	[illegible]	Annual business meeting. New officers for 1953 include the following: W. Scott McDonald, president; C. H. Meers, vice president, and I. V. Lingford, secretary-treasurer.
Southeast Branch	September 22	[illegible]	Officers elected for the coming year are: H. A. Barr, president; C. L. Davidson, vice president; and W. C. Schoeller, secretary-treasurer.
Tri-City	October 8	[illegible]	An illustrated talk on the backlog of highway work was delivered by Archie Carter, manager of the Highway Contractors Division, AGC.

More Structural Division Committees Report

Committee on Masonry and Reinforced Concrete

The principal activities of this committee, of which R. F. Blanks is chairman, are being handled by a number of subcommittees.

The Subcommittee on Ultimate Load Design (joint committee with ACI), with L. H. Corning as chairman, has given much thought to the problem of placing the design of reinforced concrete on a more scientific basis. This committee intends to prepare a manual of recommended practice for ultimate load design but in their theoretical studies found that there were inadequate experimental results to serve as a guide in formulating design procedures. At the suggestion of this committee the Reinforced Concrete Research Council was formed under the Engineering Foundation as an independent organization, to solicit funds for experimental research work in reinforced concrete and to supervise the expenditure of the funds for the best interests of the profession.

The Subcommittee on Shear and Diagonal Tension (joint committee with ACI) with Charles S. Whitney, chairman, is currently interpreting the results of experimental research work in an attempt to determine the ultimate strength of reinforced concrete members in shear and diagonal tension. New experimental research projects have been prepared. The Reinforced Concrete Research Council is supporting one of these projects and considering another.

The Subcommittee on Hipped Plate Construction, with Prof. L. C. Maugh as chairman, has already developed a theoretical analysis for this type of construction. Model tests are now being planned to indicate the adequacy of the theoretical analysis. A proposed test program has already been referred to the Reinforced Concrete Research Council for support.

The Subcommittee on Thin Shell Design, with C. S. Whitney, chairman, has completed a manual on thin shell design. This manual which outlines the principles of thin shell design for the practicing engineer, is being published by ASCE with support from the Portland Cement Association.

A new Committee on Pre Stressed Concrete (joint with ACI) with A. E. Cummings, chairman, was formed this year. An ACI Committee on Prestressed Concrete was organized in 1942 to review present knowledge of the subject, to develop design procedure, and to recommend needed research.

The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

Tractor and Level Whip Texas Mud Flats

"Recently we had a job which, at first, seemed routine – locating exterior boundaries of a Texas ranch," writes G. W. Herzog, Chief, Drafting-Surveying Division, Shell Oil Company. "Although the original Mexican grant placed the eastern boundary on shores of a lagoon and tides were involved, we anticipated no real difficulty."

"Inspecting the coast line, however, revealed several hundred acres of accreted land. Our problem soon became one of locating a line across mud flats. The land had to be contoured accurately and quickly. A close grid pattern seemed logical.

"We soon found we had misjudged the work. Our closed transit traverse was over 25 miles and some parts of the flats were over three miles across. Worst of all, by the time field work began, hard winds had covered the flats with water.

"Using temporary bench marks of pine, we ran a base line. Where bench marks were any distance at all from the shore, the flats were soft and slippery. Instruments couldn't be kept level on a standard tripod. And with so many set-ups, platform building at each point was out of the question.

On tractor, one man keeps instrument level while other is taking the rod readings.

"A light caterpillar tractor was then suggested as a surveying aid. We widened its treads to 26 inches, and a platform for the instrument man was built to the width of the treads and slightly longer. A metal frame, clearing the motor, was welded to the platform; a base of plywood fastened to the frame; and a shortened tripod bolted to the plywood.

Surveying Texas mud flats, Shell Oil Company party uses tractor with platform built for level.

"This procedure proved best: tractor was placed with longitudinal axis at right angles to, and a few feet from, the line and about 1500 feet from the turning point. While one man kept the instrument level, a second took readings. When rod passed tractor, the men changed jobs to prevent any rocking motion.

"We completed the work in one-fifth the time required by conventional methods. Again, surveyors overcame Mother Nature."

Have you received your copy of the collected stories from "The Surveyor's Notebook"? The book contains all articles and field tips from the first year's series. Thousands of surveyors are finding that it is very helpful in their work. Write for your free copy.

Send us a surveying tip for use in this continuing series. And write for Bulletin 50, giving complete details on Gurley levels and other engineering instruments.

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NEWS BRIEFS . . .

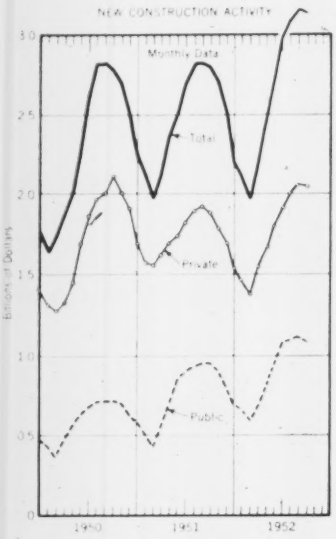
Construction Activity Remains at High Level in September

Expenditures for new construction in September totaled $3,112 million, about the same as in August, according to preliminary estimates of the Building Materials Division of the U. S. Department of Commerce and the Labor Department's Bureau of Labor Statistics. Dollar outlays for the month exceeded the three billion mark for the third consecutive time to round out the largest quarterly volume on record, $9.1 billion, as compared to $8.7 billion in the third quarter of 1951. As usual for the time of year, activity during September continued at high levels in most major construction categories. Private expenditures came to $2,037 million, and public to $1,075 million.

Comparing the record construction volume for the July-September period with that for the third quarter of 1951, the joint agencies note that both private residential building and public utilities construction were higher, and that private non-residential building was lower, each by 9 percent. Private new construction activity as a whole was up by 4 percent. Except for public housing, all major types of new public construction also showed an increase over the year, the entire public sector being 13 percent greater.

For the first nine months of this year private expenditures, at $16 billion were slightly under the 1951 total for the same period. In contrast, public construction, totaling $8.1 billion was up by 6 per cent. The joint agencies attribute the rise in public construction largely to increased federal spending for military, atomic energy, and defense plant facilities, particularly in the first half of the year.

A seasonal rise in June in production of most nonmetallic building materials, such as wood and clay products, with a decline in production of most iron and steel items, is noted by the Department of Commerce in a recent monthly industry report. The composite production index for the month, however, declined 5 percent from the May level and was 15 percent below a year ago. Although the wholesale prices of building materials were down fractionally in June, the second quarter increase of 2.6 percent in union wage scales in the building trades led to construction costs continuing their upward movement.



Construction activity in September continues at seasonal high, with Department of Commerce curves showing little change from August

Moles Announce 1953 Construction Awards

Selection of two contractors to receive The Moles' thirteenth annual awards for "distinguished service to the American construction industry" is announced by the Award Committee. The award member winner is Edward P. Palmer, M. ASCE, and the non-member winner Peter Kiewit.

A member of the New York construction firm of Senior & Palmer since 1929, Mr. Palmer has been prominently identified with the building of numerous important East Coast projects. Mr. Kiewit is head of the Omaha, Nebr., contracting firm of Peter Kiewit Sons' Co., builder of many large Western projects. At present he holds the $1,200,000,000 prime construction contract for the new AEC gaseous diffusion plant at Portsmouth, Ohio.

Edward P. Palmer

Each year, The Moles, a New York association of leaders in the heavy construction industry, honors one member and one nonmember for "outstanding contributions to construction progress." Presentation of the awards will be made at The Moles' annual dinner in the early spring.

New High in Steel Production Reported

Production of steel in the week ending October 11 was higher than ever before, according to the American Iron and Steel Institute. With the steel-making furnaces of the country operating at an average of 106.6 percent of capacity, a record total of 2,215,000 tons of ingots and steel for casting was produced. In the same week a month earlier, production totaled 2,121,000 tons and the operating rate was 102.1 percent of capacity. The Institute bases its report on data from companies having 96 percent of the steel capacity of the industry.

Power Agreement Made For New AEC Ohio Plant

The U. S. Atomic Energy Commission has made an agreement with a group of 15 private power companies, known as the Ohio Valley Electric Corp., to supply the 1,800,000 kw of electric power required to operate the Uranium-235 production plant being constructed in Pike County, Ohio (October issue, page 86). Under the terms of the agreement, the corporation will design and construct the necessary generating capacity. It must also furnish reserve capacity from its systems, and make available up to 465,000 kw of power from its existing systems for construction and early operation of the new gaseous diffusion plant, pending completion of the new generating facilities. The agreement covers a 25-year period with extensions available for the Commission.

Two steam generating plants, with a total installed capacity of 2,200,000 kw, will be built by the newly formed corporation. It is estimated that the two steam plants, for which sites have not yet been announced, will use about 7,500,000 tons of coal a year. The annual cost of power when the plant is in full operation is currently estimated at about $60,000,000.

Philip Sporn, M. ASCE, president of the American Gas and Electric Co., New York City, is president of the new Ohio Valley Electric Corp. Constituent companies are the Appalachian Electric Power Co., Cincinnati Gas & Electric Co., Columbus & Southern Ohio Electric Co., Dayton Power & Light Co., Indiana & Michigan Electric Co., Kentucky Utilities Co., Louisville Gas & Electric Co., Monongahela Power Co., Ohio Edison Co., Ohio Power Co., Pennsylvania Power Co., Potomac Edison Co., Southern Indiana Gas & Electric Co., Toledo Edison Co., and West Penn Power Co.

Salary Stabilization Board Establishes Regional Offices

As reported in the notes from the Nation's Capital, the Salary Stabilization Board has established eight regional offices to handle its work in the field. Cities and addresses are as follows: Atlanta, Belle Isle Bldg., 20 Houston St., N.E.; Boston, 52 Chauncey Street; Chicago, Builders' Bldg., 228 N. LaSalle St.; Cleveland, Great Lakes Life Insurance Bldg.; 6th & Vincent Sts.; Denver, New Customhouse Bldg., 19th & Stout Sts.; New York City, 346 Broadway; Philadelphia, Commercial Trust Bldg., 16 S. Broad St.; and San Francisco, Flood Bldg.

Regulations, interpretations, and other information will also be available through the 55 offices of the Wage Stabilization Board in various parts of the country, through an arrangement made by the Salary Stabilization Board for the convenience of engineers.

Turnpike Commission to Investigate Accidents

A critical investigation of the causes of vehicular accidents on the Pennsylvania Turnpike will be undertaken jointly by the Pennsylvania Turnpike Commission and the Union Switch and Signal, a division of the Westinghouse Air Brake Company, under an agreement that became effective October 16. The company, which has had wide experience in studying, appraising, and solving traffic problems, will assign a group of experienced engineers to work with the engineering staff of the Turnpike Commission in conducting the research. The program will seek to determine the extent of apparatus, systems, or techniques required to make turnpike travel safer. Human reaction phases of the problem will also be considered.

The J. E. Greiner Company, of Baltimore, Md., consulting engineers to the Turnpike Commission, will work cooperatively with the joint group.

Commercial Power from Nuclear Fission Studied

Production of a nuclear reactor capable of generating electric power on a commercial basis will be further advanced by the association of eleven additional public utility power companies with the Detroit Edison Co. and the Dow Chemical Co. in the joint study they are conducting in the field with the Atomic Energy Commission. The Babcock & Wilcox Co. has been associated in the joint effort since 1951. Announcement of the expansion of the joint study was made by the Detroit Edison Co. at a meeting of the National Industries Conference Board held in New York on October 17. An experimental breeder reactor, completed at Arco, Idaho, in December 1951 with a capacity of 250 kw of electric energy, has shown the technical and mechanical possibilities of using the heat produced from atomic fission to operate steam turbines.

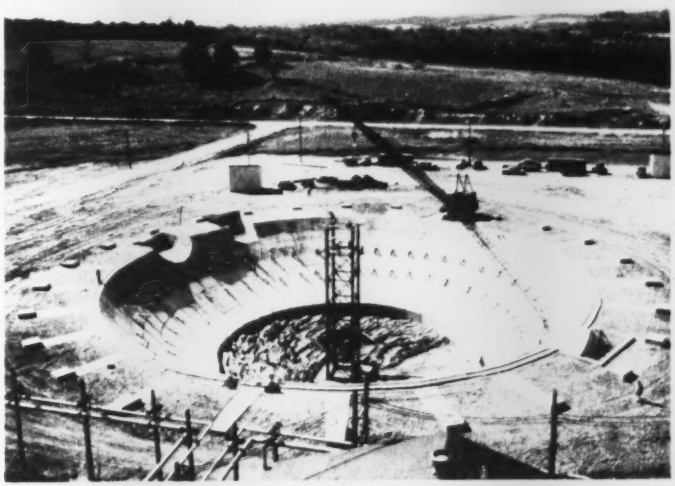
Several hundred industrial executives and engineers attended the informative two-day meeting. In a significant address, Philip Sporn, M. ASCE, president of the American Gas & Electric Co., New York, emphasized "the elementary point that nuclear energy, if and when it can be utilized to produce electric power economically, will merely provide a new form of fuel. It and the reactor producing it will thus take the place of the boiler side of a thermal electric generating station. Conventional steam turbines and all the rest of the power system from that point on will still be necessary as at present."

Lawrence R. Hafstad, director of the Division of Reactor Development of the AEC, told the group that, "The technical problems of atomic power are being solved." He explained that the fission process, which takes place in micro seconds, is accompanied by the release of tremendous quantities of heat. In a commercial power reactor the rate of fission may be controlled, but the terrific temperatures must be removed. Water is not satisfactory for the purpose because of the high pressures that go with high temperatures. Liquid metals—an alloy of sodium and potassium—have been used as coolants for the reactors and for transferring heat to the exchangers for generation of steam. "It is no child's play to control sodium and to pump it at high velocity," Dr. Hafstad stated. He, too noted that while atomic energy is a compact fuel, its use will have no revolutionary effect on the use of conventional fuels.

Other speakers agreed that the prime interest of industry at this time is in developing dual purpose reactors to produce both power and plutonium for weapons. As yet there is no clear economic incentive to generate commercial power from atomic fission. Probably a decade of development is needed to make this revolutionary source of power a practical reality.

The eleven companies named to assist in the study of atomic power are the Cincinnati Gas & Electric Co., the Cleveland Electric Illuminating Co., the Consolidated Edison Co. of New York, Consumers Power Co., General Public Utilities Corp., New England Electric System, Philadelphia Electric Co., Public Service Electric and Gas Co. of New Jersey, the Toledo Edison Co., Vitro Corp of America, and Wisconsin Power Co.

Concrete Saucer to House Navy Atomic Plant



This huge concrete saucer, 179 ft in dia and 42 ft deep, will form foundation for 225-ft steel sphere that will house an atomic power plant being built by the Atomic Energy Commission for the U.S. Navy. The project, largest ever built, is under the direction of the Knolls Atomic Power Laboratory, operated by General Electric for the AEC. Central tower and derrick used for assembling the sphere will rise to total height of 424 ft. The prototype atomic plant, the sphere surrounding it, and the associated buildings are being built on a 4,000-acre tract at West Milton, N.Y., about 18 miles north of Schenectady. Photo courtesy General Electric.

New Steel Bridges Receive AISC Aesthetics Awards

Four steel bridges have been selected as the most beautiful opened to traffic in the United States in 1951 in the American Institute of Steel Construction's annual Aesthetic Bridge Competition and will be awarded stainless steel plaques. Honorable mention will go to seven others. The winners in the contest, which has been conducted annually by the Institute since 1928, were selected by a jury of architects and engineers from a field of 97 entries.

In Class I, for bridges with spans of 400 ft or more, the award goes to the Delaware Memorial Bridge over the Delaware River three miles south of Wilmington. Owned by the State of Delaware, the structure was designed by Howard, Needles, Tammen & Bergendoff, New York and Kansas City. The consulting engineer was O. H. Ammann, M. ASCE; the consulting architect, A. Gordon Tonner; and the fabricator, the American Bridge Company.

The Foreday Channel Bridge, Davis Dam Project, Arizona-Nevada, is the winner in the Class II category for bridges with spans under 400 ft, costing over $500,000. Owned and designed by the U. S. Bureau of Reclamation, the bridge was fabricated by the American Bridge Company.

The Class III award for bridges with spans under 400 ft, costing less than $500,000, goes to the Grove Street Overpass, on Route 128 at Lexington, Mass. Designer of the structure was Thomas Worcester, Inc., of Boston, and the fabricator the West End Iron Works, Cambridge, Mass. The bridge is owned by the Massachusetts Department of Public Works.

In Class IV, for movable bridges, the winner is the Harlem River Pedestrian Bridge from East 103rd Street in Manhattan to Ward's Island. Owner-designer is the Triborough Bridge and Tunnel Authority, New York City; the consulting engineer, O. H. Ammann, M. ASCE; and the fabricator, the American Bridge Company.

Two bridges received honorable mention in Class I. They are the Los Alamos Canyon Bridge at Los Alamos, N. Mex., owned by the U. S. Atomic Energy Commission and designed by Finney & Turnipseed, Topeka, Kans., and the Atchafalaya River Pipeline Suspension Bridge at Melville, La., owned by the Transcontinental Gas Pipe Line Corp., and designed by Mathews & Kenan. Both structures were fabricated by the American Bridge Company. In Class II, honorable mention was given the Basilone Memorial Bridge over the Raritan River at New Brunswick, N. J., owned by the New Jersey Turnpike Authority, designed by Fay, Spofford & Thorndike, Boston, and fabricated by the Harris Structural Steel Co., New York City.

Structures receiving honorable mention in Class III are the Morningside Drive Underpass, North-South Freeway, Fort Worth, Tex., owned by the State of Texas and designed by the Texas Highway Department, with A. M. Gordon, supervising designing engineer and the fabricator the Virginia Bridge Company, Memphis, Tenn.; the Sacramento River Bridge at Shasta Dam, owned and designed by the Bureau of Reclamation, and fabricated by the Bethlehem Pacific Coast Steel Corp.; and the Spillway Bridge at Cedar Bluff Dam, Kansas, owned and designed by the Bureau of Reclamation and fabricated by the Kansas City Structural Steel Co. Honorable mention in Class IV goes to the Seabright Bridge over the South Branch of the Shrewsbury

Prize-winning bridges in AISC annual competition for beautiful steel bridges opened to traffic in 1951 are (top to bottom) Delaware Memorial Bridge (Class I), Harlem River Pedestrian Bridge in Manhattan (Class IV), Foreday Channel Bridge, Davis Dam Project, Arizona-Nevada (Class II), and Grove Street Overpass (lower right) at Lexington, Mass. (Class III).

River between Rumson and Sea Bright, N.J., owned by the Board of Chosen Freeholders, Monmouth County, and designed by Morris Goodkind, M. ASCE, chief bridge engineer for the New Jersey State Highway Department, the structure was fabricated by the American Bridge Company. Consultants were Howard, Needles, Tammen & Bergendoff.

ASTM Elects New Executive Secretary

The American Society for Testing Materials announces the election of Robert J. Painter as executive secretary, to succeed C. L. Warwick, A.M. ASCE, who died in April, and of Raymond E. Hess, A.M. ASCE, as associate executive secretary and editor in chief. Both promotions became effective September 16. Mr. Hess has been serving ASTM as assistant executive secretary and editor, and Mr. Painter as treasurer and assistant secretary.

Garden State Parkway To Be Self Liquidating

The projected Garden State Parkway in New Jersey can be entirely financed by state-backed 2 percent revenue bonds, without any contribution from the state, according to recent surveys made for the New Jersey Highway Authority by the New York consulting firms of Parsons, Brinckerhoff, Hall & MacDonald and Coverdale & Colpitts.

Plans for a $285,000,000 revenue bond issue to construct the parkway in three years as a completely self liquidating toll project, but guaranteed by state credit, will be voted on in the New Jersey elections on November 4. According to Ransford J. Abbott, chairman of the Highway Authority, the engineering surveys were ordered to give the voters reasonable assurance that no state funds would be required in constructing and operating the parkway. Although some sections of the parkway are completed, approval of the state-backed bond issue will permit completion of the job in a shorter time.

Extending from the New York State line in Bergen County to Cape May, the 180-mile expressway will incorporate many up-to-the-minute safety techniques. Aural as well as visual means will be employed to keep motorists from running off the pavement in the form of 3-ft safety lanes of corrugated gleaming white concrete that make a singing noise when tires encroach upon them. The dividing island separating opposing roadways will be at least 200 ft wide and planted with shrubbery and trees to eliminate the glare from approaching headlights. As an additional safety precaution, there will be no roadside ditches or sharp slopes.

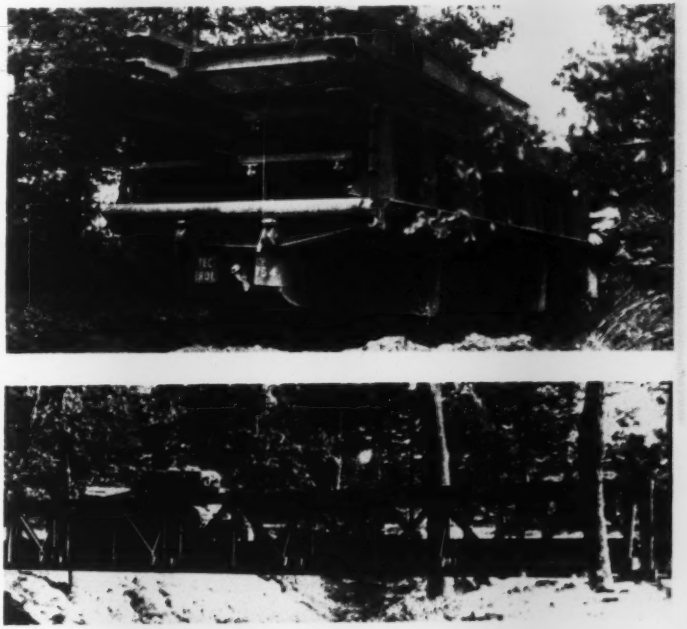
Civil Engineers Receive Welded Bridge Awards

Awards in the 1952 bridge design competition, sponsored by the James F. Lincoln Arc Welding Foundation to encourage designs conserving steel, go to civil engineers all over the country, many of them ASCE members. Designs showed an average saving in steel of approximately 20 percent made possible by welded construction.

Winner of the first award of $7,627 is Elwyn H. King, J.M. ASCE, construction superintendent for Gardner & McCall, Long Beach, Calif., whose welded design of a seven-span deck girder bridge indicates a 24 percent saving in steel over what was actually used in erecting the bridge by riveting. Kiser Dumbauld, of the Ohio State Highway Department, receives the second award of $5,635 for his redesign of one of the state's bridges. His welded design showed that an 18 percent saving in steel could have been made with a welded design. In a discussion of his design, Mr. Dumbauld said that welding used in bridges in place of riveting would permit an annual saving of 75,000 tons of steel in the bridge work on all public roads, streets, and highways. The third award of $2,078 is shared by Thomas Kavanagh, A.M. ASCE, head of the Department of Civil Engineering at New York University, and Leo Coff, M. ASCE, New York City consultant. Their design showed a steel saving of 21 percent.

Four Society members are on the list of ten engineers receiving honorable mention awards of $312 each. They are James H. Jennson, M. ASCE, Pasadena, Calif.; Horace O. Titus, A.M. ASCE, Cheyenne, Wyo.; M. O. Elkow, A.M. ASCE, of Yonkers, N.Y.; and Nan-ze Sih, J.M. ASCE, of Whitestone, N.Y.

Aluminum Fixed Bridge Expedites Army Operation



Transported by truck to erection site, Army's new T6 tactical aluminum bridge can be manually erected and can support complete army division on the move. Cooperative project of Aluminum Company of America, Pittsburgh Des Moines Co., and Army Corps of Engineers at Fort Belvoir, new structure can be erected in one-third the time required for any other bridge of similar type because of its light weight and simplicity of construction. The T6 is put together in sections, with the floor beam resting on the lower horizontal member of the truss panels. Four deck panels stretch over the floor beams to form the widened roadway. In addition to relative ease of construction, T6 offers load-carrying capacity about 50 percent greater than similar structures used in World War II. As result of its increased capacity which is due to design and to strength of Alcoa's structural alloy, 14S-T6, substantially more equipment can be transported across structure at one time.

Contractor for AEC Ohio Plant Invites Subcontractor Inquiry

Peter Kiewit Sons' Co., holder of the $1,200,000,000 prime construction contract for the new AEC gaseous diffusion plant at Portsmouth, Ohio (October issue, page 86), will welcome inquiries from interested contractors qualified to undertake various types of building and heavy construction work on a subcontract basis. The fast schedule and necessity of extremely close coordination will require prequalification of bidders.

As a first step in the prequalification procedure, the company asks that contractors interested in undertaking fixed-price work of the type that will be available furnish the following information:

1. Type of work contractor is qualified to undertake.
2. Gross volume of business by years for past five years.
3. List of specific work performed.
4. Certified bonding capacity and bonding company reference.
5. Short resume of organization and equipment available.
6. Bank reference.
7. Reference to contract and architect or engineer for whom work has been performed during past five years.

There will also be a large volume of specialty fabricated material and equipment to be purchased by fixed-price contract for the project. Manufacturers and fabricators are asked to furnish pertinent information in the form most appropriate to the industry concerned.

Information should be mailed to Peter Kiewit Sons' Co., Post Office Box 208, Portsmouth, Ohio, and marked for the attention of the Contract Awards Department.

Steel Contract Let for New Lincoln Tunnel Tube

Award of the first contract covering iron and steel required for the tunnel segments of the under river section of the Third Tube of the Lincoln Tunnel to the low bidder, the Bethlehem Steel Corp., is announced by the Port of New York Authority. The contract, which covers 46,275 tons, totals $10,620,971. Delivery of the material will start in eleven months and be completed in 28 months. Installation of the tunnel sections will begin about six months after the start of delivery. The tunnel will consist of 2,013 rings, each 31 ft in dia and made up of a small key segment and 14 segments, 5½ in long, 32 in wide, and 14 in deep.

Construction of the Third Tube, under a contract with the Gall Contracting Company of Flushing, L.I., was commenced on September 25 at a public ceremony marking the opening of the land shaft in Manhattan (October issue, page 86).

Hungry Horse Dam Is Dedicated by Truman

The $103,000,000 Hungry Horse Dam at the junction of the Flathead River and the South Fork of the Flathead in northwestern Montana was dedicated by President Truman on October 1 in ceremonies marking the first of four 71,250 kw units to go on the line. With a height of 564 ft, the dam will be the third highest in the world, exceeded only by Hoover and Shasta dams.

Constructed as an integral unit in the comprehensive program for development of the Columbia River and its tributaries, the multiple-purpose project will be operated in conjunction with Grand Coulee, Chief Joseph, McNary, and Bonneville dams and other projected developments in the Columbia River Basin for power, flood control, and irrigation. The project is being built by twelve construction firms known as General Shea Morrison under a large joint contract with the Bureau of Reclamation. Construction was begun in June 1948, and completion is scheduled for November 1953.

Technical Library Use Is Studied by ASEE

To assure maximum beneficial use of technical libraries by both engineers and organizations supporting them, the American Society of Engineering Education has initiated an Engineering Literature Project. Assuming that many engineers do not extract full value from engineering literature, the project is trying to find out why this is true and what can be done about it.

A questionnaire that can be completed by simply using checkmarks is being mailed to 1,000 engineers, selected at random from society and association directories, on November 24. Results of the survey will be of great assistance in developing a form of instruction emphasizing the engineer's outlook on the use and need of such literature. Copies of the questionnaire may be obtained by addressing the Engineering Literature Project, ASEE, % E. A. Chapman, Rensselaer Polytechnic Institute, Troy, N.Y.

Hydraulics Laboratory at Cornell Aids Industrial Testing

Tests on two large valves—24-in. butterfly valve and 20-in. Rotovalve—are being made in Cornell University's Hydraulics Laboratory. Prof. Marvin Boqema, A.M. ASCE, of Cornell School of Civil Engineering, checks disc angle on butterfly valve discharging 30 cfs directly to atmosphere. Laboratory provides gravity flow of 64 cfs under working head of 50 ft. Tests are being made at request of R-S Products Corp., of Philadelphia, and S. Morgan Smith Co., of York, Pa., to establish head loss coefficients and torque requirements for various valve positions.

Aluminum Production Sets Postwar Record

Production of primary aluminum in the United States set a new postwar record in August, with an output of 170,350,658 lb, according to Donald M. White, secretary of the Aluminum Association. The August output represented a gain of 12.5 percent over production in July and an increase of 15.5 percent over the August 1951 output of 147,630,992 lb.

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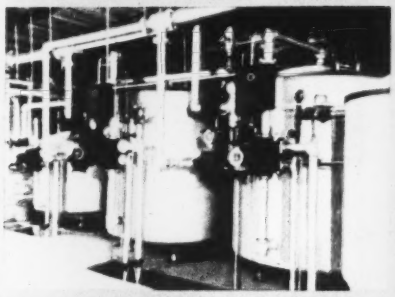

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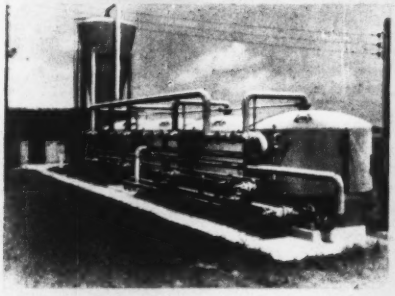

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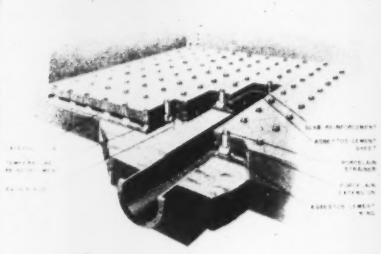

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Allis-Chalmers Acquires LaPlant-Choate Company

All property of the LaPlant-Choate Manufacturing Co. of Cedar Rapids, Iowa, has been officially acquired by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis., which has started operating it as the Cedar Rapids Work of the Tractor Division. A. O. Dennis, president of LaPlant-Choate, is general manager of the Cedar Rapids Works. Wallace Gates is works manager, and H. W. Rockwell chief engineer. Both hold the same positions in the LaPlant-Choate organization. Products of the Cedar Rapids Works will be sold and serviced through Allis-Chalmers dealers.

The rubber-tired motor scraper equipment remains on the Allis-Chalmers industrial list. This includes crawler tractor and motor grader built at the Springfield, Ill., Works, and engines, transmissions and power units made at the West Allis, Wis., Works.

Wood Research Discussed At Virginia Conference

Findings of a two-year study of trussed rafters performed by F. George Stern, M. ASCE, of the Virginia Engineering Experiment Station, and P. W. Stonebarger, of the Virginia Agricultural Experiment Station, were presented at a recent Conference on Trussed Rafters held at the Wood Research Laboratory of the Virginia Polytechnic Institute. Participating were representatives of the Housing and Home Finance Agency, the Engineering Research and Development Laboratories of the Corps of Engineers, the Small Homes Council of the University of Illinois, New York University College of Engineering, and the Timber Engineering Co. of Washington, D.C., in addition to a number of architects and manufacturers actively engaged in research on the subject.

In the two-year study 44 nailed, Bull-lock reinforced, bolted, and split ring connected trussed rafters of 20-ft span were tested to destruction. It was found that the suggested type of nailed trussed rafter, with nails in double shear, performs very satisfactorily, saves a considerable amount of lumber, and is easy to fabricate without any special tools and equipment. The newly developed rafters are already being used in the erection of demonstration houses by New York State, as designed by the Research Division of New York University under the sponsorship of the Housing & Home Finance Agency. A color film, presented by Herman Steinberg, M. ASCE, of New York University, showed the fabrication and erection of these nailed trussed rafters.

Performance characteristics of nailed and glued trussed rafters as fabricated by Structural Specialties of West Palm Beach, Fla., of split ring connected trussed rafters set forth by the Timber Engineering Co., and of the W truss suggested by the Small Homes Council were discussed and compared with the performance characteristics of the VPI designs. Since the suitability of nailed trussed rafters for both prefabrication and site fabrication is one of the principal features of the VPI design, it is expected that it will find wide acceptance especially by the small builder.

Complete results of the VPI investigation are published in the Virginia Engineering Experiment Station Bulletin No. 81, September 1952. Copies can be obtained from Dr. F. George Stern, VPI, Blacksburg, Va.

Neale's News Column

R. Robinson Rowe, M. ASCE

"I understand," said Professor Neale, "that Guest Professor Flo Rida assigned some sort of a two tank problem after I left the last meeting early to see the Centennial sights. Don't tell me, Flo, that the two tanks were named Pat and Mike."

"That's not funny," retorted Professor Rida. "Maybe I should ask you at the Centennial sights you saw were named Sally and Sam."

"Of course not." I went to the Hydraulics Division Reception and learned that seven bottles divided by 500 engineers is not very stimulating.

"Then let's get back to the two tanks," I trust that Joe Kerr has the usual wrong answer."

"I don't even know the problem," protested Joe. "Remember, I went with Professor Neale to the reception. Afterwards we ran into a Puerto Rican reception where they had 500 bottles and only seven engineers and"

"And the two tanks were named Noah and Joe! Cal, it's up to you. I'm glad you're a steady reliable lad."

"Time will tell," replied Cal Klater. "I started with a differential relation for the discharge of the upper tank

$$Q = -A\,dH/dt = CB\sqrt{2gH} \qquad (1)$$

in which A is the tank section, B is the orifice section, C is the coefficient of discharge of the orifice, and H is the stage. Using lower case letters for the lower tank,

$$q = -a\,dh/dt = CB\sqrt{2gh} = CB\sqrt{2g}\,h^{1/2} \qquad (2)$$

Dividing (2) by (1) eliminates the time factor

$$a/h\cdot A/H = b\sqrt{h}\cdot B\sqrt{H} = 1 \qquad (3)$$

Now let $h = \alpha H$ and substitute $A = 3$ and $B = \tfrac{1}{2}$, reducing to

$$-dH/H = 2a\,d\alpha/\alpha^{1/2} = 4\alpha^{1/2}\,d\alpha \qquad (4)$$

Integrating, I found $H^{1/3} = \alpha^{3/2}(1 - \alpha) = \text{constant}$, determining the latter from the initial conditions: $H = 148.84$, $\alpha = 2.9/6.1$:

$$100H^{1/3} = \alpha^{3/2}\cdot 3 = 77.91 - \alpha \qquad (5)$$

which is the general equation for the tanks. You asked for h when $H = 53.29 = 7.3^2$, substituting this and $\alpha = \sqrt{h}/7.3$,

$$729 = 10\sqrt{h}^3 = 778.73 - 10\sqrt{h}\,h \qquad (6)$$

Now, guessing that the set up was a set up and that $7.3 \cdot 10 = \sqrt{h}$ was a cube, I tried $\sqrt{h} = 0.9$, 1.6, 6.5 and 7.2, and was I lucky! The third try fit, so $h = 42.25$ in."

"You earned your luck, Cal, altho (6) is easily expanded and factored to $\sqrt{h} - 6.5$ $(h - 59.2\sqrt{h} = 351.3)$ giving your solution and two horrible redundants. How'd you like it, Noah?"

"Nice problem and an elegant solution, Flo; but I'm so sorry that Joe Kerr missed the fun. Let's give him a slightly different set up and see how he tackles it. Suppose we hold the lower tank at $a = 2$ sq ft and $b = 4$ sq in., but change the upper tank to $A = 2.5$ sq ft and $B = 5$ sq in. Then with initial stages $H = 148.84$ and $h = 33.04$ as before, let's ask him what H_1 becomes when $h = 20.16$ in. In case he does it with tin-can models, let's ask Cal to check him."

Cal Knutzen says: Richard Jenney, Stoop Chow L. Nagle, Claude H. West, Rudolph H. Meyer and Space Doc Marion Larson, Guest Professor Flo Rida was Charles G. Edson. Also acknowledged are solutions of the August daily-grain problem from Ray Kerr, Robinson Abbott and Paul Payette.]

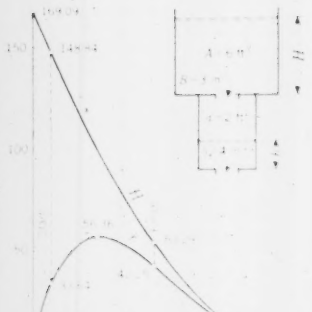

Fig. 1. Hydrographs (below) of the orifice-ometer (above) are parabolic for the upper tank and semi-sextic for the lower

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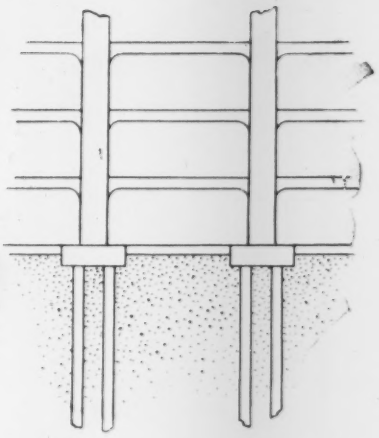

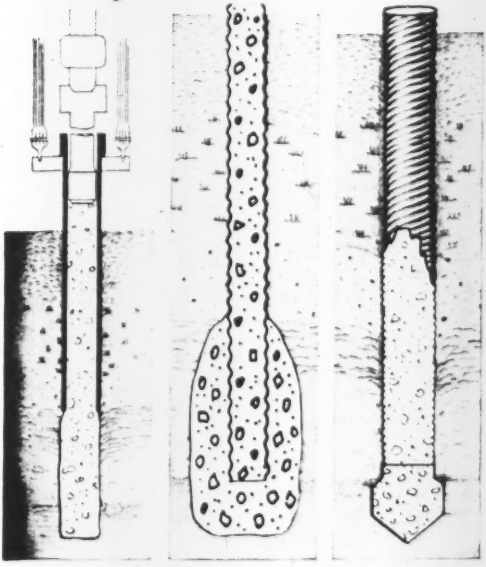

Left: Compressed Concrete Pile—A cylindrical pile of great carrying strength.
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DECEASED

Richard Vincent Hyland (M '40), partner and founder of Madigan Hyland, consulting engineers of Long Island City, N.Y., died in Southampton, L.I., on September 29, at the age of 57. Mr. Hyland was graduated from the University of Notre Dame in 1918, served in the First World War, and then became a bridge engineer with the New Jersey State Highway Department. After working briefly for C. H. Earle, Inc., of Long Island City, Mr. Hyland and M. J. Madigan organized the firm of Madigan-Hyland. Among the many notable projects on which they have acted as consultants are the Triborough and Bronx-Whitestone Bridges, the Belt Parkway and the Henry Hudson Parkway. At present the firm is serving as consultant to the New York State Thruway Authority. Mr. Hyland was a former president of the Moles, New York society of heavy construction men.

Richard V. Hyland

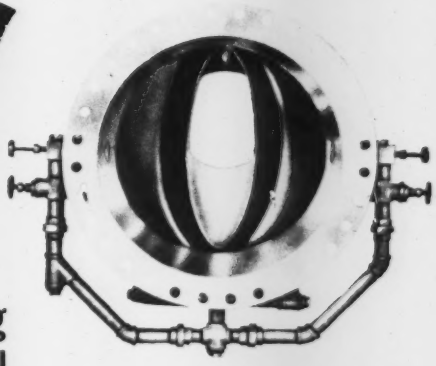
Harold Bedford Atkins (A.M. '02) of Jacksonville, Fla., died there on May 10, 1952, according to word just received at Society Headquarters. He was 80 and a graduate of Stevens Institute of Technology (class of 1892). An industrial engineer and efficiency expert, Mr. Atkins developed a system of business analysis. He was a member of the American Society of Mechanical Engineers and the New York Society of Public Accountants.

Roger Wellington Armstrong (M. '29), consulting engineer to the New York City Board of Water Supply since his retirement from the Board in 1948, died in a hospital in Morristown, N.J., on August 24. He was 72. Following graduation from Tufts College, Mr. Armstrong was employed for three years as assistant engineer on hydrologic projects for J. R. Freeman. In 1906 he joined the engineering staff of the Board of Water Supply as assistant engineer advancing to chief engineer. Mr. Armstrong was connected with the construction of the Catskill water supply system and was in charge of design of the Delaware water supply system.

Lawrence Spalding (M. '38), valuation engineer for the Bessemer & Lake Erie Railroad Co., Pittsburgh, Pa., died at his home in Greenville, Pa., on August 8. He was 62. Associated with the railroad continuously for 38 years, Mr. Spalding had served in several capacities, including draftsman, supervisor, principal assistant engineer, valuation engineer and director. He received a degree in civil engineering from Cornell University in 1913.

(Continued on page 82)

New!



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The major dimension of the throat's ellipse is in the vertical plane . . . and equal to the diameter of the circular main section. This permits a horizontal invert . . . a flat, straight bottom that is self-scouring of sediments or solids.

Another outstanding feature is the straight, flat top of type VE venturi tube. This prevents the accumulation of air or gas which—in conventional tubes—could impede liquid flow and enter instrument pressure lines causing faulty readings.

The circular inlet and outlet readily fit existing mains. Teamed with a Simplex Venturi Meter, this new Type VE venturi tube will accurately measure low-velocity sediment-bearing liquids under a wide range of pressures.

For further information, write to Simplex Valve & Meter Company, 6724 Upland Street, Philadelphia 42, Pennsylvania.

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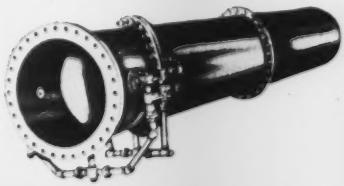

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31 years on the river

THIS WOODEN BARGE is made of Koppers Pressure-Creosoted Wood. It has been in constant service for 31 years, and has never required repairs because of decay.

In 1921 the Ayer & Lord Tie Co. built a fleet of barges for hauling cross ties on the Cumberland and Tennessee Rivers to Brookport, Illinois. River barges take a terrific beating from constant exposure to water, weather, and rough handling; so they must be not only physically strong but also highly resistant to decay. To get these characteristics at low cost, Ayer & Lord built their barges with pressure-creosoted wood.

The choice was a good one. Today, after 31 years of constant river service, these barges, now owned by Lyerly, Inc., are still in regular service hauling cross ties on the Cumberland and Tennessee Rivers. In all these 31 years, *no wood has had to be removed from any of the barges because of decay.*

Permanence At Low Cost

These barges are another example of the ability of Koppers Pressure-Creosoted Wood to provide long and dependable service under extremely difficult conditions. Koppers scientific pressure treatment forces creosote deep into the wood and *permanently* protects it from rot, marine borers, insects and decay. And this improved wood *costs less* than other permanent construction materials.

If you want permanent construction — at low cost — it will pay you to consider *first* Koppers Pressure-Creosoted Wood. For more information, write today to Koppers Company, Inc., Pittsburgh 19, Pa.

KOPPERS COMPANY, INC., PITTSBURGH 19, PA.

KOPPERS **PRESSURE-TREATED WOOD**

Deceased

Continued from page 81

Herbert Ray Cochran (A.M. '29) construction engineer with the National Production Authority, Washington, D.C., died on August 8, at the age of 58. Mr. Cochran who attended Drexel Institute of Technology, was with the Rowdhouse Arey Co. and William F. Lotz, both of Philadelphia, for some years. Later he was connected with the federal government in various capacities, including that of acting chief of the Federal Public Housing Authority, Washington, D.C., and civilian chief, Air Installations, Robins Air Force Base, Robins, Ga.

George Thomas Dean (A.M. '31) since 1946 chief of the engineering division of the Veterans Administration at Reno, Nev., died there on May 30, at the age of 44. Mr. Dean received both the bachelor and master of science degrees from Kansas State College. For several years he was connected with the Kansas Highway Commission and the Missouri Highway Department, and later was assistant professor of civil engineering at Alabama Polytechnic Institute. He served with the U.S. Navy during World War II, winning several decorations. He was injured and retired from the Civil Engineer Corps with the rank of lieutenant.

Joseph Patrick Dever (M. '46) for the past two years associate engineer for Charles A. Maguire & Associates, Boston, Mass., died at North Scituate, Mass., on August 19. He was 57. In the municipal service of Boston for more than 35 years, Mr. Dever had been in the Public Works and Transit Departments, chief engineer of the Sewerage Division of the Metropolitan District Commission, and chairman of the Boston Transit Commission. He was also associate commissioner of public works for the Commonwealth of Massachusetts. From 1946 to 1949 he was manager of the Boston office of the Cohasset Construction Corp.

Andrew Jack Thompson (A.M. '39) senior civil engineer, 6th Naval District, Charleston, S.C., died on July 29, at the age of 44. For several years, Mr. Thompson was connected with the Texas Company Refinery at El Paso, Tex., and for more than ten years he was draftsman and structural engineer with the Corps of Engineers at Huntington, W.Va. In 1947 he became connected with the Public Works Department of the Navy. Mr. Thompson had attended Marshall College.

Charles Andrew Randorf (M. '13) president of Charles A. Randorf, Inc., industrial representatives of Buffalo, N.Y., died there on August 21, at the age of 72. Starting his career as a draftsman with the Lackawanna Steel Co. (now the Bethlehem Steel Co.), Mr. Randorf had advanced to structural engineer at the time of his resignation in 1919. Projects on which he was engaged during this period included the Grand Central Terminal in New York. He worked with the Cooper Co. on the Muscle Shoals Dam project, and in later years established his own company, in association with his two sons. He was a veteran of the Spanish-American War, and had studied at Harvard.

Benjamin Franklin Batchelder (A.M. '25) sanitary engineer of Boonton, N.J., died in a Morristown, N.J., hospital on August 18, at the age of 75. For over 30 years Mr. Batchelder had been associated with the firm of Clyde B. Potts, sanitary engineer of New York, N.Y. He was also connected with the Gray Chemical Company, Igoe Brothers, and the U.S. Land Service. Mr. Batchelder received a degree in civil engineering from the Thomas S. Clarkson Memorial School of Technology in [illegible].

Harrison Worth Nighswonger (M. '23) of Oklahoma City and Ada, Okla., died on July 22, at the age of 64. For 39 years Mr. Nighswonger was one of the principal engineers of the Benham Engineering Co., Oklahoma City, except for an 18-month period of Army service in World War I. He studied at the University of Michigan and was a civil engineering graduate of the University of Oklahoma in 1912. During World War I, Mr. Nighswonger served as first lieutenant, Quartermaster Corps, at Camp Funston, Kans., and in World War II was on the engineering staff of the Benham Engineering Co., Architect-Engineer on army camps in Louisiana. At the time of his death he was one of the principals on the company's work at the McAlester Naval Ammunition Depot in Oklahoma.

H. W. Nighswonger

Edward Walter Cunningham (M. '13) retired structural engineer of Glendale, Calif., died at Ravenswood, W.Va., on September 1. He was 80 years old. Before entering private practice in 1927, Mr. Cunningham served the city of Cleveland, Ohio, as assistant commissioner and commissioner of buildings. He was vice president and chief engineer of the Gloyd Construction Co., Cleveland, and was consulting engineer with Austin & Ashley, Los Angeles architects. He was an alumnus of Ohio State University, class of 1892.

Walter Ellsworth Rowe (M. '22) actively engaged as a member of the firm of Rowe & Chapman since his retirement as dean of the University of South Carolina school of engineering, died at his home in Williston, S.C., on September 5. He was 77. A graduate of the University of Nebraska, Dean Rowe had been professor of mathematics at Trinity Hall School and the University of New Mexico, professor of civil engineering at Oklahoma Agricultural and Mechanical College and Drexel Institute of Technology, and dean of engineering at the University of Kentucky and the University of South Carolina (from 1922 until his retirement). He had served as consulting engineer to the South Carolina Public Service Authority.

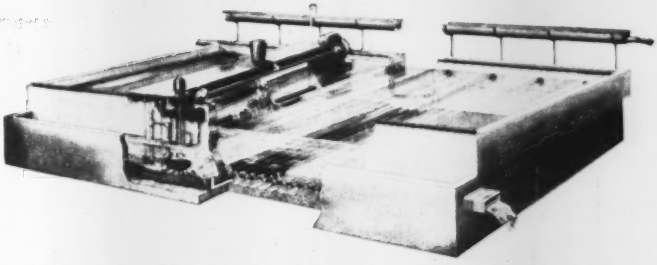
Continued on page 84

• CIRCULAR CLARIFIERS—THICKENERS

Hardinge Circular Clarifiers for water treatment are available in sizes up to 200' diameter either center column or bear supported for steel, concrete, wood or tile tanks. Bulletin 33-C-37.

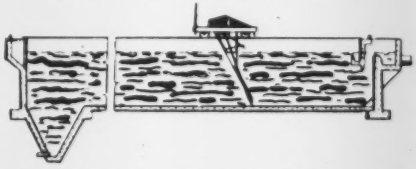
Hardinge Thickeners for removal of fine suspended solids from supply water and sewage are similar to the Clarifiers but of heavier construction. "Auto Raise" mechanism prevents scraper breakage. Bulletin 31-D-37.

• AUTOMATIC BACKWASH RAPID SAND FILTERS



For high removal of non settling or slow settling suspended matter. Self cleaning sand bed. No shutdown necessary for backwashing. Bulletin 40-37.

• RECTANGULAR CLARIFIERS



Especially suited for limited spaces or where sludge delivery is desired at one end of the tank. Bulletin 35-C-37.

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Deceased

(Continued from page 83)

Walter Arthur Fisher (M. '20) managing director and engineer of W. Arthur Fisher Ltd., Wellington, N. Z., died at his home in that city on August 16 at the age of 70. Before going to New Zealand in 1923, Mr. Fisher had been a member of the Los Angeles firm, Glass & Fisher, and connected with the Western Water Co., at Taft, Calif., and the Valley Natural Gas Co., at Bakersfield. In New Zealand, he was the manager of Frozen Products Ltd., from 1925 until 1928, and since 1928 had been managing director of W. Arthur Fisher Ltd., construction engineers and machinery importers.

Otto Ernest Hager (M. '30) engineer of bridges and structures for the Chesapeake and Ohio Railway at Detroit, Mich., died there on July 14, at the age of 50. Mr. Hager had previously been connected with the New York, Chicago & St. Louis Railroad Co., at Cleveland, Ohio, for 10 years, and the Pere Marquett Railway at Detroit for seven years. He was an alumnus of Lehigh University.

Howard Davison Hilborn (M. '38) chief engineer of the structural division, Empsco Derrick & Equipment Co., at Houston, Tex., died at his home on September 6. He was 65. After graduation from Allegheny College and a year of study at Cornell University, Mr. Hilborn worked for the Chicago, Burlington & Quincy Railroad Co., the Concrete Engineering Company, Omaha, Nebr., and the Cudahy Packing Co. He also had a private practice for several years in Miami, Fla. With the Empsco Derrick & Equipment Co., for 20 years, he had been chief engineer since 1941.

Fred Bacon Greenleaf (M. '30) died in Auburn, Me., on September 13, at the age of 69. A native of Auburn and a graduate of Dartmouth College and the Thayer School of Engineering, Mr. Greenleaf served three terms as Republican representative in the Maine House and two terms as State Senator. He had been in charge of the Planning Survey Division of the Maine State Highway Department and at the time of his death was treasurer of the Greenleaf Construction Co., of Auburn.

Archibald Rogers Livingston (M. '07) retired engineer of Medford, Oreg., died at his home on August 22, at the age of 84. Mr. Livingston served overseas during World War I, holding the rank of major at the time he was mustered out. Prior to his service in the armed forces, he was superintendent for the Empire Zinc Co., at Canyon City, Colo. He had been retired since 1919. Mr. Livingston was an alumnus of the Columbia University School of Mines.

Stanley Albert Kerr (M. '35) retired engineer of Inglewood, Calif., died in that city on September 17, at the age of 68. After graduation from Pennsylvania State College in 1907, Mr. Kerr entered the U. S. Reclamation Service (now the Bureau of Reclamation) and rose to project manager. In 1924 he left the USBR to engage in private engineering practice with J. B. Lippincott in Los Angeles. Mr. Kerr returned to the Bureau in 1930 and remained until his retirement in 1950.

George Washington Kelly (M '44) senior associate engineer, Department of Public Works, Bureau of Sewers, Baltimore, Md., died on July 7, at the age of 63. A member of the Bureau of Sewers for over 30 years, Mr. Kelly began as a junior civil engineer, advancing to chief designing engineer of sewers and then senior associate engineer. Earlier he had been employed by the Baltimore & Ohio Railroad, the Bethlehem Steel Co., and the Baltimore Bureau of Drafting. He was an alumnus of Baltimore Polytechnic Institute.

Ernest Samuel Rafuse (M '51) assistant civil engineer in the Massachusetts Department of Public Utilities at Boston, died in Chelsea, Mass., on August 26. He was 56. A member of the utilities department since 1943, Mr. Rafuse had served as railway inspector for 13 years and since 1946 had been assistant civil engineer. Earlier in his career he was connected with the Boston & Maine Railroad as assistant bridge inspector and bridge inspector in the terminal division, and assistant supervisor of bridges and buildings.

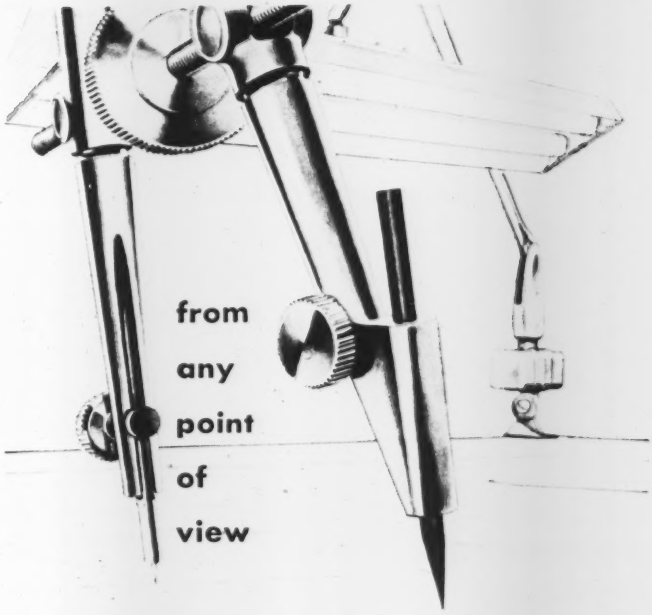
Harrison Smith (M '46) a partner in the New York City engineering firm of Sanderson & Porter, died August 21 at his home in Greenwich, Conn. His age was 71. After graduating from Rensselaer Polytechnic Institute, Mr. Smith was engaged as superintendent of construction on projects in Chicago and New Orleans, and worked briefly for the New York State Department of Highways, at Buffalo, N.Y. Following that he engaged in subway and drydock construction. He joined the firm of Sanderson & Porter in 1921 and had been a partner since 1930.

Dana Watkins Robbins (M '16) former mayor of North Miami, Fla., died on May 14, 1951, according to information recently received at Society Headquarters. Educated at Massachusetts State Agricultural College, Mr. Robbins was employed as a construction engineer on a railroad at Cienfuegos, Cuba, and with a foundation company at Richmond, Va., before entering the contracting business in 1918 with Ludlow Mebus. In 1927 he moved to Dade County, Florida, and engaged in building construction. He was elected mayor of North Miami in 1943.

Henry Ernest Williams (M '35) project manager, Utah Construction Co., of San Francisco, Calif., died in that city on April 7, following a heart attack in his office. He was 66. After several years in diversified fields, Mr. Williams entered construction work. Since 1937, he had been with the Utah Construction Co., holding the positions of chief estimator, chief engineer, and project manager.

Wilbur Thomas Wilson (M '38) died on August 11, at his home in New York, N.Y., in his 80th year. His work was principally with the Metropolitan Park Commission of Massachusetts, the Massachusetts State Highway Commission, the Charles River Basin Commission of Massachusetts, and for 37 years until his retirement in 1944, with the Board of Water Supply of the City of New York.

(Continued on page 86)



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Deceased

(Continued from page 85)

Edward Herbert McConnell, M. ..., retired consulting engineer of Roanoke, ..., died there on May 20 at the age of ... He was graduated in civil engineering at the University of Virginia. Mr. McConnell had been a locating and construction engineer for the Virginian Railway and the Norfolk Railway & Light Co., and engineer of maintenance for the Roanoke Railway and Electric Co. and the Lynchburg Traction and Light Co. He was also locating engineer for the Chinese government railway at Ichang, China. During World War I he served as a captain in the U. S. Army.

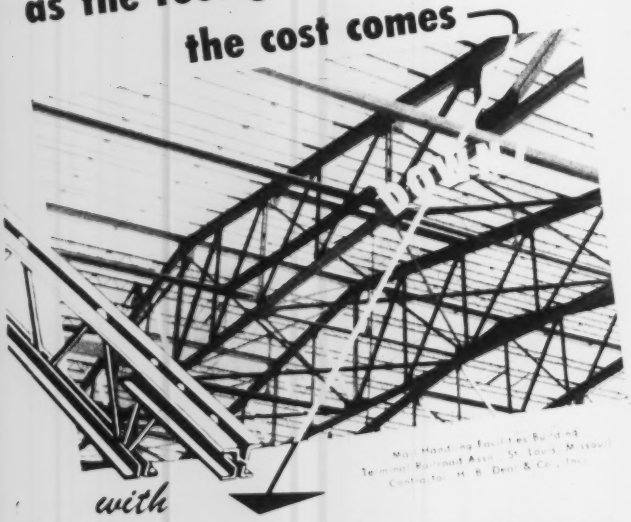
George Bruce Palmer, M. ..., president of George Bruce Palmer, Inc., Detroit, Mich., since 1948, died on November 5, 1951, according to information recently received at Society Headquarters. He was 80. Mr. Palmer was with the Detroit Ship Building Co., continuously for 51 years, advancing from draftsman to chief engineer. He left there in 1905 to act as consulting engineer for the Michigan Alkali Co., and its subsidiaries, the Wyandotte Transportation Co., and the Wyandotte Terminal Railroad Co., and later became head of the firm of George Bruce Palmer, Inc.

Robert Follansbee, M. ..., retired federal engineer of Denver, Colo., died there on July 22, at the age of 73. A member of the U. S. Geological Survey from 1901 until his retirement in 1948, Mr. Follansbee was district engineer in charge of water resources at Denver from 1912 on. He was a graduate of Cornell University.

Charles Orton Lasley, A.M. ..., retired engineer of Colorado Springs, Colo., died at his home on July 28. He was 81. Early in his career, Mr. Lasley was associated with Rigg and Sherman, consulting engineers, and A. Bentley & Sons, Co., both of Toledo, Ohio. From 1913 until 1928 he was a partner in the general contracting firm of Moxley and Lasley in Toledo. Since then Mr. Lasley had served at various times as assistant engineer and building inspector for the city of Colorado Springs, and was in charge of the Public Works Administration for the district.

John Cornelius Penn, M. ..., professor emeritus of civil engineering at the Illinois Institute of Technology, Chicago, died there on July 20, at the age of 71. Professor Penn was associated with the Institute and its predecessor, the Armour Institute of Technology, from 1910 until his retirement in 1948. At Armour, which was his alma mater, he had filled many offices, including those of chairman of the administration committee, and head of the department of civil engineering. Before joining the Armour faculty he was assistant engineer in the Chicago Bureau of Bridges.

as the roof goes UP...
the cost comes



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NEWS OF ENGINEERS

G. Brooks Earnest, acting president of Penn College, Cleveland, for the past eight months, has been elected president, and will be formally inducted into office in the spring. Professor Earnest went to Penn in 1951 as dean of engineering after twenty years as an engineering teacher at Case Institute of Technology. He is just commencing a term as Vice President of ASCE for Zone III (photo and story, page 91).

Thomas R. Camp and **Herman G. Dresser**, Boston consultants, announce the admission to partnership of their associates, **Roland S. Burlingame, Joseph C. Lawler** and **Darrell A. Root**. Their practice will be continued under the firm name of Camp, Dresser & McKee, as in the past.

Stewart Fischer, formerly traffic engineer for the Texas Highway Department on construction of the Houston Expressway, has been appointed traffic engineer for San Antonio, Tex.

Lincoln B. Grayson, formerly civil engineer with the Hydroelectric Commission of Tasmania, has accepted a position as regional engineer with the Snowy Mountains Hydroelectric Authority of Australia, Kosciusko region, Island Bend, N.S.W.

Charles E. Sloan, engineer of bridges for the Baltimore and Ohio Railroad at Baltimore, Md., has been named engineer of bridges and buildings. Mr. Sloan has been connected with the railroad continuously since 1915.

William H. Nalder is retiring as chief designing engineer of the Bureau of Reclamation after 45 years of continuous service in the development of Western water supplies. He became connected with the Bureau in 1906, and has been chief designing engineer since the retirement of **John L. Savage** in 1945. In 1949 Mr. Nalder accepted a request from Trygve Lie, United Nations Secretary-General, to be a staff adviser on irrigation to the U.N. Economic Survey Mission for the Middle East. He is on the executive committee of the ASCE Hydraulics Division.

William H. Nalder

Philip M. Botch, civil engineer and land surveyor, is now licensed in structural engineering in the State of Washington. His headquarters are at Bellevue, Wash.

Fred H. Baker, previously head of the structural engineering department at the Iowa Ordnance Plant of the Silas Mason Co., Burlington, has been transferred to the ordnance division.

Benson L. Dutton, chairman of the school of engineering at the Tennessee Agricultural & Industrial College, Nashville, was elected national secretary of the National Technical Association at its 24th annual meeting at Howard University, Washington, D.C.

Louis J. Capozzoli, Jr., has just returned to the consulting engineering firm of Motam, Proctor, Mineer & Rutledge in New York, N.Y., after two years' service in the U.S. Army. While in the service, Mr. Capozzoli worked at the Engineer Research and Development Laboratories at Fort Belvoir, Va., and with the Post Engineer at Fort Meade, Md.

Miles D. Catton, since 1949 director of development of the Portland Cement Association, Chicago, has been appointed assistant to the vice president for research and development. Succeeding Mr. Catton as director of development is **Douglas McHenry** who joined the Association after eleven years of service with the U.S. Bureau of Reclamation at Denver, Colo.

H. H. Cooper Jr., ground water district engineer for the U.S. Geological Survey in northern Florida since 1946, has been designated staff engineer of the ground water branch of the Water Resources Division. He will act as adviser to the ground water district offices in North Carolina, South Carolina, Georgia, Florida and Alabama, and will continue to have his headquarters in Tallahassee, Fla.

Ralph P. Johnson, manager of the Los Alamos Field Office of the Atomic Energy Commission, is returning to the Santa Fe Operation Office as deputy director of engineering and construction. **Paul A. Wilson**, until recently director of the division of engineering and construction at Los Alamos, now holds the post of director of community management there.

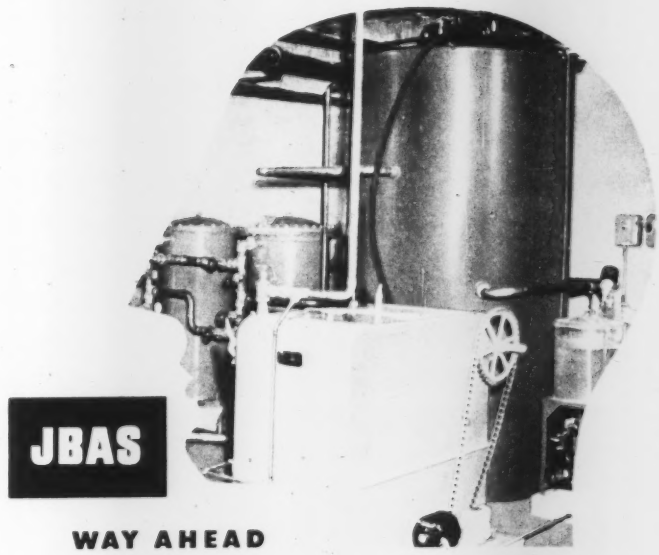
Alexander V. Karpov, consulting engineer of New York City, has left for a United Nations mission to Yugoslavia. He recently returned from a similar mission to Pakistan.

William D. Jordan, for the past two years research assistant in the department of theoretical and applied mechanics at the University of Illinois, has been appointed associate professor in the department of engineering mechanics at the University of Alabama. Professor Jordan received his bachelor of science degree and master's degree from the University of Alabama.

Joseph R. LeBlanc has resigned from the U.S. Bureau of Reclamation project at Hungry Horse, Mont., to accept a position with Giffels and Vallet, Detroit engineers and architects, on construction of the AEC plant at Paducah, Ky.

Paul F. Keim, consulting engineer and associate of Knappen Tippetts Abbett McCarthy, engineers of New York and San Francisco, has been appointed professor of civil engineering at the University of California, Berkeley. He will be responsible for professional courses in the construction field. Professor Keim expects to retain associate status with Knappen Tippetts Abbett McCarthy, and be available for consultation in the offices of the firm.

Continued on page 94



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The source of water doesn't matter, jbas versatility has been demonstrated in hundreds of installations treating 5 to 100 gallons per minute . . . equally effective for softening, clarifying and sterilizing or removing organic matter, tastes and odors . . . providing a water supply to meet the most exacting standards.

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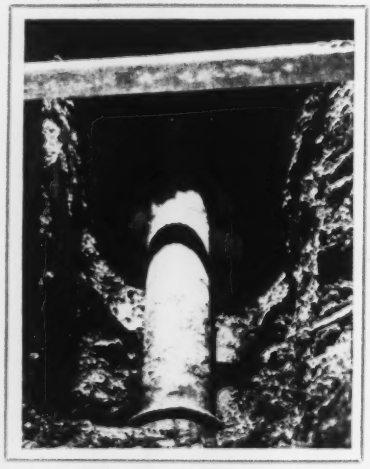
This pipe saves tax dollars

Generations of taxpayers have been saved millions in taxes by the long life of cast iron pipe in America's water distribution systems. For example, more than 35 cities have cast iron mains in service that were installed over a century ago.

Yes, cast iron pipe has saved, and is today saving, millions in tax dollars—but that is not all. Street excavations to replace short-lived pipe cost money in disruption to traffic and retail trade, not to mention the expense of installing new pipe and repairing costly pavement. Cast iron pipe saves these avoidable costs. And the dependable service of cast iron mains in high-pressure fire-fighting systems has saved millions in fire losses. Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 South Michigan Ave., Chicago 3, Illinois.



This cast iron water main installed in Alexandria, Virginia, 100 years ago is still rendering satisfactory service. Over 35 other American cities have century-old cast iron mains in service.

CAST IRON

CAST IRON PIPE

America's No. 1 Tax Saver

1952 Cast Iron Pipe Research Association

— but that is not all

News of Engineers

Continued from page 87

George Grove has been promoted from field engineer at the Phoenix office of Howard, Ferguson & Carollo, to manager of their office at Tucson.

Virgil E. Gunlock, commissioner of superways and superhighways, Chicago, Ill., has succeeded **Oscar E. Hewitt** as commissioner of the Chicago Department of Public Works.

Harold B. Hammill, consulting civil engineer, announces the removal of his office from 581 Bush Street to 417 Market Street, San Francisco, Calif.

Laurence S. Hensley, formerly of the Durham, N.C., contracting firm of T.W. Pue and Sons, Inc., has been appointed assistant professor of civil engineering at North Carolina State College. He will teach courses in the construction curriculum.

John C. Hennessy has been transferred from the U.S. Bureau of Reclamation's Hungry Horse project to the 9th Naval District at Great Lakes, Ill., where he holds the position of construction superintendent.

David J. Brumley has transferred from the engineering and construction division of the Hanford Operations Office of the Atomic Energy Commission in Richland, Wash., to the engineering and construction division of the Portsmouth Area Office at Portsmouth, Ohio, where he will be engaged on design and construction of the AEC's new gaseous-diffusion plant.

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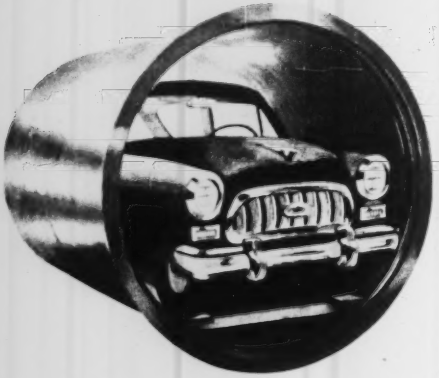

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Charles M. Hunter has been commissioned a second lieutenant following graduation from the 26-week Engineer Officers' Candidate School at the Army Engineer Center, Fort Belvoir, Va. He was previously associated with Banks & Lee, Inc., Washington, D.C.

Cornelius Bruinooge, engineer with the Esso engineering department of the Standard Oil Development Co., in Linden, N.J., has been sent to Bombay, India, as an assistant resident engineer on construction.

S. Logan Kerr, consulting engineer of Philadelphia, Pa., announces the removal of his offices to 1518 Bethlehem Pike, Flourtown, Pa.

Douglas S. Laidlaw, formerly connected with Moran & Morris, Toronto architects, is now in the civil employ of the Royal Canadian Air Force as siting engineer in Air Material Command. Mr. Laidlaw's principal responsibility will be to choose the project sites for Air Force construction projects.

H. S. Mattimore, engineering consultant of Colonial Park, Pa., has joined the staff of Miller-Warden Associates, Swarthmore, Pa., where he will head the civil engineering section. Mr. Mattimore is well known for his work with the American Society for Testing Materials and has been chairman of the Committee on Materials and Research of the American Association of State Highway officials.

A. Jay Medford has returned to his post with the U.S. Bureau of Public Roads in Phoenix, Ariz., after an extended tour of duty with the U.S. Navy engineers. Mr. Medford is a former secretary of the Arizona Section.

Frank Goodman, formerly city engineer of Winslow, Ariz., and one-time Arizona State Highway engineer, has moved from Winslow to Holbrook, Ariz., to become city engineer.

Oliver J. Todd has associated himself as consulting engineer to the engineering office of **L. Cedric Macabee**, 156 University Avenue, Palo Alto, Calif.

William A. Johnson will represent Armco Drainage & Metal Products, Inc., throughout Arizona, after completion of an indoctrination course at Berkeley, Calif. Mr. Johnson was formerly associated with the Salt River Valley Water Users Association, Phoenix, Ariz., as field engineer.

Gene M. Randich has been commissioned a second lieutenant, following graduation from the Engineer Officers' Candidate School at the Army Engineer Center, Fort Belvoir, Va. Lieutenant Randich graduated from Purdue University in 1951 with a bachelor of science degree in civil engineering.

Harry B. Rasch has been appointed manager of Latin American Sales by Infilco Inc. (formerly the International Filter Co.). Mr. Rasch has been with Infilco for 24 years and until his present appointment was assistant manager of the Public Works Division. His headquarters will remain in Tucson, Ariz., where the general offices of Infilco are located.

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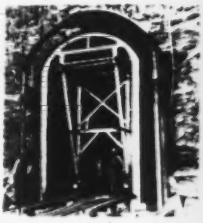

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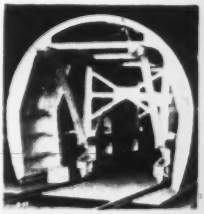

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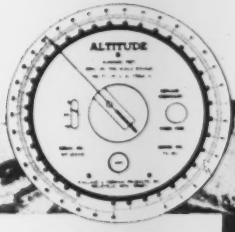

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CIVIL ENGINEER, J. M. ASCE, 28, married. M.S. soil mechanics, structures. 3 years, 44 persons, with Aerogenic contractor in South America as office, field and design engineer on hydroplant railroad, highway and building construction and design. Speaks Spanish, German and French. Will go overseas. C-784

SANITARY ENGINEER, J. M. ASCE, 32, married, B.S., sanitary engineering, Penn. State, 1942. 3½ years' experience with consulting engineers, 1½ years with consulting engineer on own. Responsible for design, construction and operation of water treatment plants, industrial waste studies, laboratory and field work. Prefer Eastern location. C-785

SANITARY ENGINEER, J. M. ASCE, single, 29, wishes to return to Southeast Asia or Mexico. Licensed professional engineer, B.S. and M.S. in sanitary engineering. Civil federal rating. Speak Spanish. Familiar with design, construction and maintenance of sanitary works. Eight years' progressive experience in U. S. A., Canada, Latin America and Mexico. C-786

CONSTRUCTION ENGINEER, J. M. ASCE, desires affiliation with expanding company in the construction or allied fields. Graduate, private pilot, 33, married, 10 years' diversified experience at top management level. At present chief engineer for large corporation. Will relocate. C-787

STRUCTURAL ENGINEER OR CONSTRUCTION EXECUTIVE, M. ASCE, 44, married, registered structural engineer in three states. M.S. in structural engineering. 18 years' construction contracting and design experience. Reached executive 4 years' administrative and research. Desires position as consultant or with contractor. Location preferred, West coast. C-788 (SC) A-6 San Francisco

CIVIL ENGINEER, J. M. ASCE, degree, licensed land surveyor. 3 years' experience with railroad in design and layout of track and drainage facilities, right of way matters. 1 year as topographical officer, Corps of Engineers. Desires position with consulting firm or contractor. Location, Mid West or West. C-790

STRUCTURAL ENGINEER, M. ASCE, 30, graduate civil engineer, registered in Ohio. 10 years' experience in design, estimating and construction of fixed and movable bridges, buildings and dams. Willing to relocate and travel in Mid West and Western United States. C-790

CIVIL ENGINEER, M. ASCE, 35, married, graduate, registered civil engineer in California, speaks French fluently. 6 years' structural design, buildings, waterfront work, power plants, 6 years' city office and design engineer, streets, sewerage, drains, docks, bridges, seeks executive engineering position in France or French possession. C-791 (SC) A-2 San Francisco

Positions Available

INSTRUCTOR OR ASSISTANT PROFESSOR in civil engineering, to handle instruction in surveying. Must have advanced degree. Salary open. Location, New England. Y-6960

HYDRAULIC OR SANITARY ENGINEERS, 35-40, technical graduate, experienced in this field, capable of structural and hydraulic design for company in the municipal field involving investigations, reports, design and supervision of construction of water supplies, treatment and distribution, sewage collection and treatment, airfield storm drainage, streets and related types of work. Should be able to make investigations and prepare engineering reports, meet and discuss projects with clients. Should have Southern background. Salary open. Location, South Carolina. Y-7070

ENGINEER, B.S. in civil engineering or equivalent, to include most of the following courses: Dynamics, aerodynamics, differential equations, statistics, stress analysis, structural design, to plan, conduct and evaluate field tests of operational engineering techniques as applied to certain phases of atomic energy program. Will consider a recent graduate. Salary, $4,410-$7,000 a year. Location, Virginia. Y-7202

INSTRUCTOR in civil engineering, to teach in the fields of fluid mechanics and soil mechanics. Should have at least an M.S. degree, and preferably a doctor's degree. Must be citizen. Salary open. Location, Connecticut. Y-7274

GENERAL SUPERINTENDENT with several years' experience in operation and engineering in connection with water supply company. Salary, $7,800-$8,400 a year. Location, East. Y-7290

STRUCTURAL DESIGNER with at least 10 years' steel and concrete experience, to design and lay out office buildings, service stations, garages, etc. for utility company. Salary, $6,000 a year. Location, New York, N.Y. Y-7301

INSTRUCTOR OR ASSISTANT PROFESSOR in civil engineering, preferably with M.S. degree, to teach structural engineering. Salary, $4,500-$5,200 a year. Location, northern New Jersey. Y-7374

RECENT CIVIL ENGINEERING GRADUATE for engineering field service on low cost road construction. Highway experience desirable. Good opportunity with national organization. Location, Southeast. Y-7387

CIVIL ENGINEER OR GEOLOGIST, experienced with the technique of airphoto interpretation for the preparation of engineering soil maps. Location, New Jersey. Y-7402

SANITARY ENGINEER, civil graduate, with at least 5 years municipal or public health experience to survey projects, plan installations of sewers and general sanitary facilities. Considerable traveling in U. S. and trips to foreign countries. Salary, $7,000 a year. Location, Washington, D.C. Y-7435-S

SANITARY ENGINEER, civil graduate, with at least 5 years' experience on design and operation of sewage collection and disposal systems and a thorough knowledge of sanitary requirement for municipal operations. Salary open. Location, Pennsylvania. Y-7440

PROFESSOR in civil engineering, 35-40, for the school year 1953-1954, to act as department head. Should have engineering and teaching experience. Salary, $4,500-$5,000 for 9-10 months. Location, Pennsylvania. Y-7446

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ARCHITECTURAL ENGINEER 28-35 with building maintenance and construction design and specification experience, to design and lay out institutional facilities, prepare specifications and interpret designs into actuality. Salary $6,500 a year. Location New York, N.Y. Y-2402

ASSISTANT CHIEF ENGINEER 40-50 civil engineering graduate with professional engineer's license and at least 5 years administrative and supervisory design, estimating, engineering and construction experience covering buildings, air fields, bridges and heavy construction to analyze and evaluate projects, prepare estimates and assume engineering responsibilities for schedules, costs and general problems. Salary $15,000-$18,000 a year. Location New York, N.Y. Y-2721.

CONSTRUCTION ENGINEER with pipeline marine terminal, tank car and truck station experience to supervise design changes, field engineering, and equipment installation. One year contract. Salary $9,600-$10,200 a year. Location North Africa. Y-2795.

ENGINEER, construction, structural or civil, under 45, technical graduate, with 2 years' experience in construction engineering work for field and office work in connection with building construction. Salary $4,000-$5,000 a year. Location, New York, N.Y. Y-2680-S.

CONSTRUCTION SUPERINTENDENT, not over 47, M.E. or C.E. degree with at least 10 years experience in heavy construction involving a considerable length of time in full charge of the projects. Must have had petroleum refinery or heavy industrial chemical plant experience. Will be 100 percent field work at the actual construction site. Salary $7,200-$7,500 a year, plus expenses. Locations throughout the United States. Y-2629.

CIVIL ENGINEERS for work in sales promotion. Should have design and construction background. Salary open. Headquarters Cleveland, Ohio. Territory Detroit, Cleveland or Pittsburgh areas. Y-2663.

SANITARY ENGINEER 30-45 graduate, with degree in sanitary engineering or civil engineering with minor in sanitary engineering or chemistry, and at least 5 years experience in a waterworks system, public health activities in sanitary engineering consulting practice or in sanitary engineering sales. Will act as assistant to water supply superintendent, to supervise the water purification and sanitary engineering sales. Must be U. S. citizen. Salary $5,388-$6,644 a year to start. Location, Florida. Y-2664.

SUPERINTENDENT OF CONSTRUCTION, to take complete charge of large project, reinforced concrete industrial building. Salary open. Location, Maryland. Y-2023.

DESIGN ENGINEERS, with experience in water works hydraulic studies, cost estimates and specification writing, for water operating company. Salary $6,000-$7,200 a year. Location, New York, N.Y. Y-2674.

CIVIL ENGINEER, Ph.D. or equivalent in experience. Reinforced concrete experience desirable. Knowledge of reinforced plastics an asset. Versatility in the field of structures a prerequisite. Salary $7,000 a year and up. Location, Washington, D.C. Y-2677-S.

ENGINEERS, (a) Landscape engineer with highway experience to be responsible for grading, fillets, on highways, access roads and bridges. Salary $6,000-$8,000 a year. (b) Progress report engineer with highway and heavy construction progress report experience and schedule preparation. Salary $7,000-$8,000 a year. (c) Topographical draftsman for highway layout work. Salary $4,200-$6,000 a year. Location, central New Jersey. Y-2681.

SUPERINTENDENT OF PUBLIC WORKS AND VILLAGE ENGINEER engineering degree or equivalent, 27-35, with 3 years experience preferably as city engineer or assistant. Experience in city public works maintenance activities. Will direct program of street, sidewalk, streetlight, storm and sanitary sewer maintenance, administer building code enforcement, make studies of proposed installations by subdividers, act as engineering advisor. Salary $6,000 a year. Employer will pay fee. Location, suburb of Chicago, Ill. R-9201.

FIELD ENGINEER (promotion), civil, up to 30, with at least 1 year's experience in highway construction, inspection of soils work. Will assist in promotion and technical servicing of soil cement streets, roads and airports. Will contact builders, construction engineers and users. Salary open. Employer may negotiate fee. Travel 50 percent of the time. Location, Chicago, Ill. R-9256.

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The Economic Design of Rectangular Reinforced Concrete Sections

Factors arising in the design of rectangular reinforced concrete sections subjected to direct compression, direct tension, and bending moment form the subject of this book by C. P. Siess and Nathaniel Newmark. A chart for each of these factors is made leading to design charts for various conditions. The optimum arrangement for economy is established in each case. An appendix shows how simple slide rules may be set up for the solution of working-stress direct from strain energy considerations. (Pitman Publishing Corp., 2 West 45th St., New York, N.Y., 1950. 76 pp. $2.75.)

The Conservation of Ground Water

This book by Dr. Harold E. Thomas of the U.S. Geological Survey presents a survey of available information on the present development and use of ground water in the United States conducted under the sponsorship of the Conservation Foundation. It summarizes the natural and legal factors involved in ground water development. Basic principles are reviewed and the experience of 70 areas in 35 states is discussed. Several maps show the ground water situation over the country. (McGraw-Hill Book Co., New York, N.Y., $5.)

Talsperren-Messtechnik

This book by A. E. Huggenberger is intended to provide a generally understandable review of methods of measurement, instruments, apparatus and equipment for testing massive concrete structures. Actual discussion is limited to dams, covering general observations on behavior, physical and structural characteristics, model tests, and some treatment of dam tunnels. It is expected, however, that application to other massive structures will be readily made. (Springer-Verlag, Reichpietschufer 20, Berlin W 35, Germany, 1951. 142 pp. DM 22.50.)

Mechanics and Properties of Matter

This text, by Reginald J. Stephenson, stresses the physical concepts involved in mechanics while presenting as well the mathematical procedures involved. The importance of these concepts in the whole field of physics is demonstrated. Vectors and simplified vector analysis are used throughout the book to familiarize the student with their use. Illustrative problems occur in the text and practice problems accompany each chapter. (John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 1952. 371 pp. $6.)

Handbuch Des Wasserbaues

Continuing the revision of this classic work by Armin Schoklitsch, this second edition of the second volume covers in detail the hydraulic structures connected with dams and outlet works, hydraulic power stations, drainage and irrigation, river and canal engineering. Over 2400 section drawings and photographs illustrate the text. Volume I, issued in 1951, covered hydrology and hydraulics, water supply engineering, sewerage and sewage disposal. The two volumes comprise a complete treatise on the subject. (Springer-Verlag, Vienna, Austria, 1952. 566 pp. $47.)

Graphic Methods for Solving Problems

This book by Frank A. Heacock, professor of graphics at Princeton University, is intended as a reading guide to recent literature on graphic methods as applied to the solution of technical problems in various fields of engineering, science, and industry. An explanatory text precedes the bibliography in each of the eight sections. Simple graphs and charts, the hydrograph, geometric diagrams, network charts, vectors and mechanics, descriptive geometry, nomographs, graphic analysis. Over 600 references are given, from 1937 to 1950, with a brief abstract or annotation in each case. (Available from Princeton University Store, Princeton, N.J., 1952. 113 pp. $1.90 postpaid.)

Conformal Mapping

The potential theory and complex function theory necessary for a full treatment of conformal mapping are developed in the first four chapters of *Conformal Mapping* by Zeev Nehari, making the reader independent of other texts on complex variables. This section, suitable for a first course in the subject, is followed by a graduate-level treatment of the various techniques available for the conformal mapping of given geometric figures as well as discussion of the mapping properties of special functions. A working knowledge of advanced calculus is a prerequisite. (McGraw-Hill Book Company, Inc., 330 West 42nd St., New York 36, N.Y., first edition, 1952. 396 pp. $7.50.)

Building and Civil Engineering Plant

The object of this work, by Spence Geddes, is to make available a comprehensive book of reference on building and civil engineering equipment, to make possible a considered approach to its purchase, and to aid in its efficient application and operation. The opening chapters discuss the practical and economic considerations involved in the selection and operation of the equipment, while succeeding chapters describe the equipment itself, classified by work types and covering construction features, application, operation, output, and the apportionment of labor to the equipment required. (Crosby Lockwood & Son, Ltd., London, 1951. 302 pp. 40s.)

Civil Engineering Reference Book

The forty-eight chapters comprising this work, each written by a recognized authority, present in condensed form the information basic to civil engineering work of all kinds. In addition to a general treatment of mathematics, physics, chemistry, mechanics, etc., and technical descriptions of all types of construction, transport and water supply work, there are special chapters on statistics, specifications and quantities, explosives and fire protection. The editors are E. H. Probst and G. Connie. (Butterworths Scientific Publications, London, obtainable through Butterworth & Co., Ltd., Toronto, Ontario, 1951. 1,700 pp. $22.)

Coast Erosion and Protection—Studies in Causes and Remedies

The author, R. R. Minikin, critically examines and analyzes the effectiveness of various forms of shore and beach protection and the behavior of the encroaching water under all sorts of conditions. He establishes certain general principles but emphasizes the necessity of studying and taking into account local conditions. Physical and geological aspects are discussed, construction details illustrated, and numerous examples cited in detail. (Chapman & Hall, Ltd., 37 Essex St., London, W.C. 2, England, 1952. 240 pp. 30s.)

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La Vibration du Beton

Translated and adapted from Spanish into French, this book begins with the basic properties of concrete and continues with discussion of the aims and advantages of the vibration treatment in placing concrete. It covers the consistency, workability, composition, and water-cement ratio of concrete, methods of compaction, vibration theory, conditions and equipment for the vibration treatment, and the various methods used. The author is G. Barcelo, and the translator M. J. Recouard. Editions Eyrolles, Paris, 1952. 212 pp., frs. 1,300.

Prestressed Concrete Structures

This book provides a basic understanding of methods of analysis on prestressed concrete structures for the man in the field as well as for the research man. After a general survey of principles and systems, the author, August E. Komendant, describes the important materials and their properties. The theory of design of prestressed structures and the analysis of carrying capacity are dealt with at length, covering continuous beams, trussed girders, and prestressed shells. A number of representative prestressed structures already built are discussed with critical comments and suggestions for improvement. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N.Y., 1952. 293 pp., $6.

Reclamation in the United States

Written by the Director of Programs and Finance of the Bureau of Reclamation, Alfred R. Golze, this text provides a comprehensive treatment of the entire subject, bringing the irrigation and hydroelectric power components together and developing their interrelations and interdependence. All recent advances in the field of water resource development in the Western states are covered, particularly the development of the multiple purpose project. Topics discussed include the complex engineering and economic investigations prerequisite to the construction of projects, problems involved in marketing electric energy, irrigation water conservation, and sprinkler irrigation. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N.Y., 1952. 431 pp., $8.50.

Die Wassererschliessung

This comprehensive treatise on the finding and developing of underground water supply sources, sponsored by Deutscher Verein von Gas- und Wasserfachmannern, is divided into two main parts. Part I deals with general geohydrology, the chemistry of ground water, well sinking, and the installation of equipment, the adaptation of spring flows, pump calculations, and estimate of yield. Part II covers geoelectrical prospecting methods, including the limitations and range of applications and discussion of the electrical characteristics of water bearing ground. Vulkan Verlag, Dr. W. Classen, Essen, 1952. 421 pp., DM 68.

A Textbook of Mechanics

Here, in one volume, J. G. Jagger has covered all the ground the average engineering student is likely to need in his study of statics and dynamics, mechanics of machines, elasticity and vibrations, hydrostatics and hydraulics. Each chapter progresses from the introductory to a reasonably advanced level, stressing fundamental principles but including many illustrative technical applications. The work is also available in four separate volumes. Blackie & Son Limited, 17 Stanhope St., Glasgow, C.4, Scotland, 1952. 826 pp., 60 s.

Transportation Principles and Problems

Designed for college courses in transportation, this textbook by Truman C. Bigham and Merrill J. Roberts covers railroads, motor carriers, pipelines, airways, and inland, coastwise, and intercoastal waterways. These forms of transportation are treated jointly from a functional point of view with the primary purpose of promoting the establishment of more rational transportation policies. A historical and factual introduction is followed by material on transport legislation. McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N.Y., 1952. 710 pp., $6.

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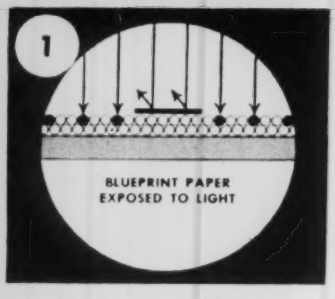
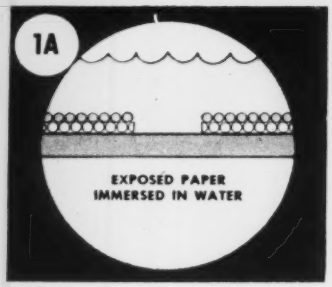
Why is a blueprint



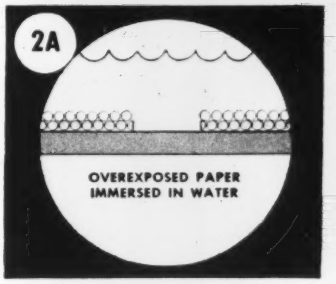
Simplified diagram of enlarged cross section of blueprint paper shows surface particles of the coating being struck by light. The coating, which is pale in color, contains two soluble ferric salts: a cyanide complex and an organic acid. Light reduces some of the ferric to ferrous ions in the exposed areas, producing a mixture of both. Opaque lines in a superimposed drawing prevent the light from reaching the coating beneath, as shown by the black bar in the center.



In the presence of water, the ferrous ions in the exposed areas react with the cyanide complex to form a ferrous-ferricyanide, which is Prussian Blue. (This is the famous blue pigment, insoluble in water, discovered in Berlin in 1704.) The areas that were shielded from light contain only the original soluble salts. These are washed away by the water, exposing the white paper beneath. The print then has white lines on a blue background.

Contrary to ordinary photographic processes, moderate overexposure of a blueprint has two good effects. It permits light to penetrate beneath the surface of the coating and thus to act in depth. It also reduces more of the surface salts from the ferric to ferrous condition, including the cyanide complex. But carried to an extreme, overexposure causes light to penetrate the opaque lines of a drawing with a resultant loss of contrast in the developed print.

BLUE?



When a moderately overexposed print is immersed in water, the ion mixtures react together. However, the colorless ferrous compounds that are formed on the surface of the coating cover up the layers beneath, and tend to hide the Prussian Blue color which has formed in the bottom layers. The print, at this stage, will have a grayish cast without full contrast.

Nearly every blueprinter, after washing the prints, immerses them in a solution of potassium dichromate, or peroxide. These are oxidizing agents that reverse the effect of too much light, changing a proportion of the ferrous ions back to ferric ions. In this way, with the help of overexposure, the entire thickness of the coating can be made effective in forming Prussian Blue. A deep, rich blue, contrasty print results.

● As one of the oldest reproduction processes, blueprinting has undergone little development until recent years. CHALLENGE* blueprint papers embody every valuable advance made in this time and, in addition, are produced with the extra skill and care that go into all K&E products. The presence of more colloidal Prussian Blue, plus a pre-coating process, enable CHALLENGE papers to provide more vivid white lines against a background of deeper, more intense blue.

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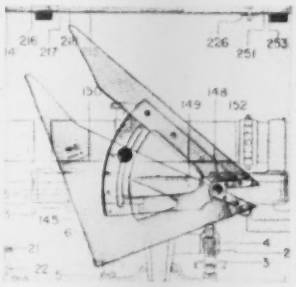

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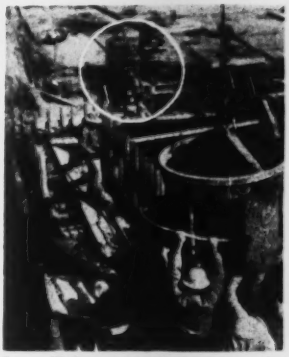

Stang Wellpoint installation surrounding pit as construction proceeds in the dry.

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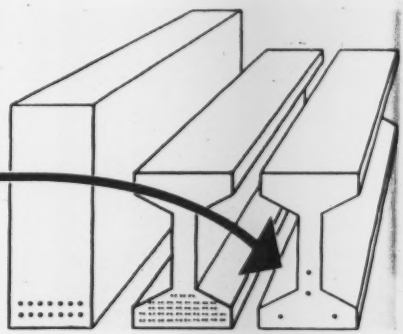
for prestressing



	Conventional reinforcement	Prestressing wires	STRESSTEEL bars
Steel:	11–3" diam. bars	28–0.196" diam. wires	4–1" diam. Stressteel bars
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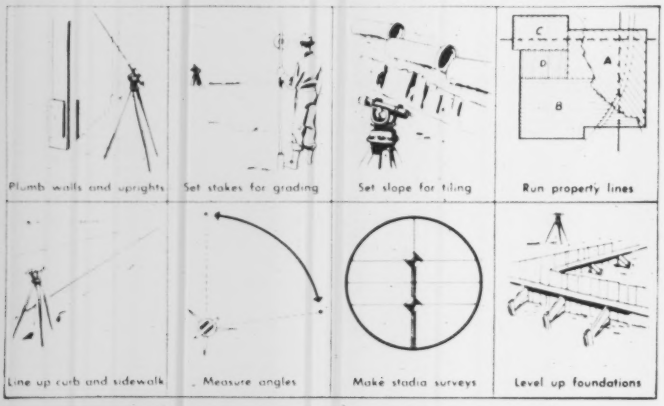

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A second century . . .

(Continued from page 53)

supply or other similar problems. Not so for general long-range predictions of the trends in the next century! Sources of power and other factors not now fully visualized bid fair to change greatly the trends we are now following. As President Conant, of Harvard University, has said in his book, *Education in a Divided World*, Harvard Press, 1948:

> The only working hypothesis for Americans, it seems to me, is a belief that by the collective use of our intelligence and a mobilization of our good intentions we can mold the history of the next fifty years within certain limits. To speculate beyond fifty years is an interesting but unprofitable undertaking.

Come what may, it is my hope that our profession and our Society will be found ready and willing to do its part.

The American Society of Civil Engineers has been a guiding light throughout my career. To me it is a living thing, not an assemblage of bylaws, reports, and administrative matters; nor is it merely a forum for the delivery of technical papers, although its contribution in this line has been outstanding. Through its channels have come some of my most valued friendships and personal acquaintance with those of our profession who have given inspiration and leadership. In short, it has supplied all of those things which come from association with a living thing. It also reflects the spiritual life of those who have gone before.

With God's help I hope that the effectiveness and influence of our Society will increase under my stewardship.

Solution to problem on page 45

Water, under high pressure, has been forced back into the seams and interstices of the rock. With the quick release of pressure when the tunnel was emptied, the water thus stored functioned as one continuous charge of slow blasting powder. The action was analogous to that which may burst the ear drums or produce "the bends" in the human system following too rapid a transition from low to high, or from high to low, pressure.

Non-ASCE Meetings

American Concrete Pipe Association. The association will conduct its second annual short course school of instruction for representatives of member companies on November 20, 21, and 22. Classes will be held at the Sherman Hotel, Chicago, Ill., under the direction of John G. Hendrickson, A.M. ASCE, research engineer of the American Concrete Pipe Association. Howard F. Peckworth, M. ASCE, managing director of the Association, will be one of the speakers.

American Petroleum Institute. The 32nd annual meeting of the American Petroleum Institute will be held in the Conrad Hilton Hotel and the Palmer House, Chicago, Ill., from November 10 to 13.

American Society of Mechanical Engineers. Headquarters for the annual meeting of the ASME will be the Statler Hotel in New York City and the dates November 30 to December 5. The 20th National Exposition of Power and Mechanical Engineering will be held under the auspices of ASME, in Grand Central Palace, New York City, from December 1 to 6. Admission is free, and only members of the profession are invited.

Illinois Traffic Engineering Conference. The 18th annual Illinois traffic engineering conference will be conducted on the campus of the University of Illinois at Urbana on December 11 and 12. The conference is sponsored by the department of civil engineering at the University, in cooperation with the Illinois Division of Highways, the Mid-West Section of the Institute of Traffic Engineers, the Illinois Traffic Safety Council, and the Illinois Municipal League.

Inter-American Association of Sanitary Engineering. Argentina will be host to the third congress of the Inter-American Association of Sanitary Engineering, which will meet in Buenos Aires late in November. Further information is available from Charles L. Pool, secretary of the association, 1501 New Hampshire Avenue, N.W., Washington 6, D.C.

Industrial Wastes Conference. The Oklahoma Water, Sewage and Industrial Wastes Conference will be in session on December 4 and 5, on the campus of Oklahoma A & M College, Stillwater, Okla.

Society of Naval Architects and Marine Engineers. The 60th annual meeting of the Society will be held in the Jade Room of the Waldorf-Astoria, in New York, N.Y., November 12-15.

American Institute of Chemical Engineers. Headquarters for the annual meeting of the AIChE will be the Cleveland and Carter hotels in Cleveland, Ohio, from December 7 to 10.

American Society of Sanitary Engineering. The American Society of Sanitary Engineering will hold its annual meeting in Miami, Fla., from November 15 to 20.

Continued on page 102

The NEW Acker Teredo Core Drill . . .

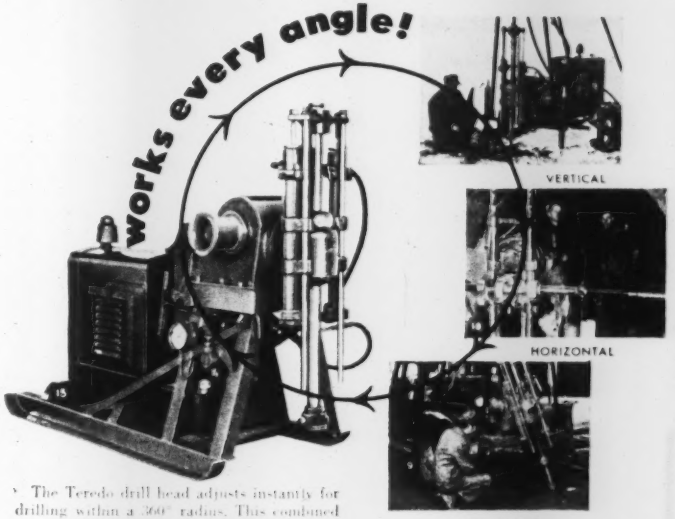

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Illustration shows Sauerman Tautline Cableway working on Chastang Dam. Two identical machines with spans of 1146 ft. and conveying speeds of 1300 f.p.m. handle all the materials going into this dam. Mixed concrete is handled in 8 cu. yd. dump buckets; other materials in skips and slings.

Operating above the working area—never interfering with other operations, a Sauerman Tautline Cableway efficiently hoists, conveys, and places any material at any spot within its span, reaching out as far as 3,000 ft. if necessary. The machine may have stationary towers, mobile head and tail towers moving in unison, or one mobile tower operating radially around a stationary tower or anchorage.

Not all Sauerman Tautlines are as big as the one pictured at left. In contrast with this huge machine, which easily lifts and carries 25-ton loads, are the general utility type machines with operating spans up to 500 ft. and lifting capacities up to 5 tons. One of these simple, semi-portable small machines often handles all the materials in the construction of an ordinary bridge or similar structure, taking the place of derricks, cranes, concrete buggies, etc.

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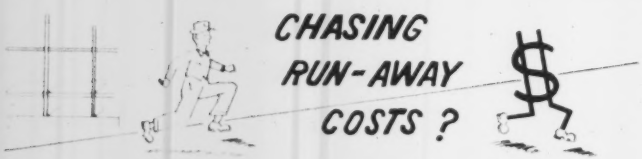

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Non-ASCE Meetings

(Continued from page 101)

Society for Experimental Stress Analysis. The fall meeting of the society includes an annual exhibit, and two technical sessions to be held jointly with the American Society of Mechanical Engineers. Headquarters for the program will be the McAlpin Hotel, New York, N.Y., from December 3 to 5.

Chi Epsilon. The New York alumni chapter will hold a meeting in the Engineering Societies Building, Room 1101, 33 West 39th St., New York, N.Y., on December 3, at 7:30 p.m., to be preceded by an informal dinner in the New York Times Dining Room, 11th floor, 229 West 43rd St., at 6 p.m.

Second Illinois Structural Engineering Conference. The Illini Union Building at Urbana, Ill., will be the headquarters of the second University of Illinois structural engineering conference, to be held November 12 to 14.

Positions Announced

City of Alhambra, Calif. Announcement is made of the availability of a position as assistant engineer in the street and engineering department of the City of Alhambra, Calif. The starting salary is $367 per month. Further information and application forms may be obtained from Ronald F. Dunn, Personnel Director, City of Alhambra, Box 251, Alhambra, Calif.

Veterans Administration. At the present time there are a large number of openings with the Veterans Administration in Washington, D.C., for sanitary design engineers, construction engineers, construction management engineers and structural design engineers at entering salaries ranging from $4,205 to $7,040 per year. There are also vacancies for engineers experienced in estimating construction costs and approving specifications, at a salary of $5,940 annually. VA positions are also open in other locations. Inquiries should be addressed to the Departmental Personnel Officer, Veterans Administration, Washington, D.C.

Maryland State Planning Commission. The Department of Employment and Registration, Baltimore, Md., in cooperation with the Maryland State Planning Commission, is recruiting applicants for the position of Planning Engineer I, at an annual salary of $5,000. The applicant must be a college graduate or a licensed professional engineer in Maryland and have ten years' experience, or have a master's degree and five years' experience. Inquiries regarding the position and requests for application blanks should be addressed to the State Employment Commission, 31 Light St., Baltimore 2, Md.

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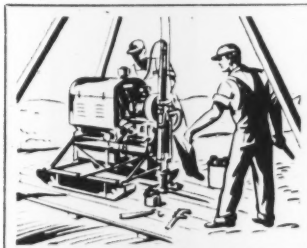

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Clifford Junior Fuller, Frankfort, Ky.
Walter Roberts Hargitay, Washington, D.C.
Winfred Louis Hindermann, Minneapolis, Minn.
Felix Samuel Jackson, Washington, D.C.
Fritz Leonhardt, Stuttgart, Germany
Robert Winfield Looby, Tallahassee, Fla.
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Albert Carl Sears, Ogden, Utah
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Khalid Shibli, Berkeley, Calif.
Ola Axmund Svenson, Roscoe, N.Y.
Adolfo Tricot, Montevideo, Uruguay

[Applications for Junior Membership from ASCE Student Chapters are not listed.]

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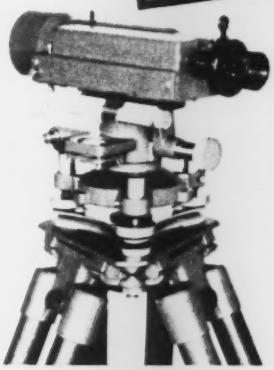

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EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Pumps

A line of heavy duty, high pressure, duplex axial reciprocating type pumps is being introduced. Capacities range from 300 gal to 2700 gph. These pumps are called Lancaster Giants and are slow speed, double acting and self lubricating. They are powered by either electric motor or gasoline engine. The smaller models have herringbone gears while the

Lancaster Giant

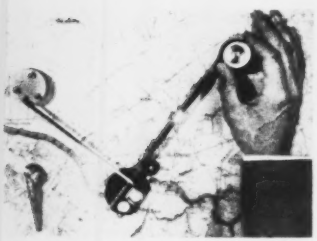
large units have helical precision cut gears. Compact, silent and efficient operation Lancaster Giants are designed for industrial water supply or heavy duty applications for boiler feed and condensation return and are available with a great variety of plungers and valves to suit individual requirements, liquids, etc. **Lancaster Pump and Manufacturing Co., Inc., Lancaster, Pa.**

Forms

Extra-large concrete forms that can be used up to 100 times are constructed on a fast-locking principle that permits ready adaptation of panel size to a wide variety of dimensions. The Rubwall form construction consists of wooden cleats which are fitted together and hinged at the intersection points. After adjustment at the job site to the desired panel dimensions, the form is covered with sheathing paper for rough finished work, or with a concrete liner of plywood or composition board for a smooth finish. The paper or board is easily tacked in place on the form, and is stripped off after the concrete has set, leaving the Rubwall form clean and ready for reuse. In addition to their adaptability to various panel sizes, these forms can be curved for forming circular walls, thus eliminating the expense of constructing circular wood forms. Other savings result from the fact that the crossed beam action of the struts gives additional structural support which reduces the amount of shoring required by almost 50 percent. For a 4-in floor, support spacing can be as large as 28 in. **Kurt Orban Company, Inc., 205 East 42nd St., New York 17, N. Y.**

Optical Planimeter

The OPTICAL PLANIMETER known as the F S 246 V is now available. It incorporates several outstanding improvements which provide better precision and easier operation. The old type needle point tracer has been replaced by a lupe convex, magnifying lens that eliminates squinting by allowing the operator to look through it at the magnified line to be followed. This same improvement precludes errors of parallax. Both the counting wheel and the measuring wheel can be brought to a zero reading with a simple flick of the reset lever. Planimeters available heretofore had to be manually set to a zero reading. The only alternative was to note the reading at the beginning of measurement and then to subtract this value from the final reading for the correct result. The tracer arm has graduations from 0 to 20 thousandths of a sq in per vernier unit and may be easily adjusted by using the roll button. A precise clocking gage is included with each instrument. When used as directed, it will give an exact measurement of 10 sq in with each revolution about its



F S 246 V

tracing pin. From this precisely known area and its resultant wheel reading the true setting of the tracer arm may be computed. The F S Model 246 V is manufactured by Filotechnica Salmoraghi of Milan, Italy. Their American representative is **Trans-Global Company, 1480 Broadway, New York 36, N. Y.**

Sweeper

An AUTOMATIC TERRAIN compensator recently added to the company's super sweeper line has now been added to the standard sweeper line. The spring loaded float device automatically compensates for uneven terrain and maintains a constant broom-ground contact pressure. This assures uniform sweeping and eliminates ridges of dirt on uneven ground. The Lull standard sweeper is available in 5 ft, 6 ft, and 7 ft models. **Lull Manufacturing Company 314 West 90th St., Minneapolis, Minn.**

Shovel Attachment

The SCOOP SHOVEL is a new product just announced for use on underground or surface loading operations. The device consists of a front end attachment that may be applied to any basic full revolving TL-25 turntable and is interchangeable with standard shovel, crane, clamshell, dragline and hoe attachments. The Scoop Shovel is equipped

Scoop Shovel

with a 1½ yd dipper in place of the ¾ yd dipper used on the standard TL-25 shovel. The shovel attachment consists of a short rugged boom 5 ft 6 in in length, at the front end of which is located a cable driven shipper shaft with pinions located at the outer ends of this shipper shaft. The dipper is attached to a double dipper stick which is crowded in or out in a telescope manner through dipper stick sleeves rigidly fastened to the outer end of the boom. The underside of each dipper stick is equipped with a rack or teeth which mesh with the pinions on the outer ends of the shipper shaft. Thus by proper control of the reversible shipper shaft, the dipper and dipper stick may be crowded out or retracted. Depending on the position of the boom the machine can load, on down grade, on a level grade or on an up grade. When the boom is lowered to a horizontal position, the dipper may be moved in or out through a stroke of 6 to 7 ft. **The Thew Shovel Co., 1000 E. 28th St., Lorain, Ohio.**

Magnetic Tagline

A MAGNETIC TAGLINE for use on clamshell or electro magnet services, has been developed. The tagline consists of a drum, mounted on the extension of the hoisting drum shaft, which is provided with a series of permanent magnets. By their magnetic attraction to the flange of the tagline drum, a constant pull is exerted on the tagline rope. Different pulls can be obtained by varying the number of magnets on the job. Important features are its permanency, it requires no adjustment and no maintenance. It is a definite improvement over track type taglines, or one requiring clutches, springs, and other parts. **The Osgood Company, P. O. Box 515, Marion, Ohio**

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Equipment, Materials & Methods (Continued)

Trailer Dumps

A LINE OF SINGLE axle packaged trailer dumps of up to 20 cu yd capacity is announced. Known as Galion Model 12, the body is constructed of 10 gauge steel. It is 88 in wide inside and has 32 in sides and 44 in ends. Standard equipment includes 12 in steel removable side boards. Length can be varied up to 18 ft to provide any desired yardage capacity. Dumping is handled by a Galion Model 77142 hoist. This consists of two 7 in twin ram single stage telescopic cylinders. Rated hoist capacity is 18 tons. The trailer suspension is of heavy duty alloy main and auxiliary springs, one fixed and one adjustable radius rod, with flat top frame section. It is furnished with either a power fifth wheel or wet hose mounting. Tire sizes and brakes are available in several options to meet individual load and service requirements. The Galion Allsteel Body Company, Galion, Ohio.

Road Widener

A TOOL, DESIGNED to lower costs of road widening by contractors or public officials, has been announced. The new, patented attachment for the "Cat" motor grader is named the Domor road widener.

Attachment for Motor Grader

The road widener is a moldboard frame and roller device that is easily attached to the regular motor grader blade. Mounting requires only a few minutes. The rollers guide the plow-like blade along the edge and lip of the paving. The cutting edge scours the edge of the paving as it cuts a trench to exact specifications. Depth and width of cut are adjustable, to fit each job's requirements. Operation is through the grader controls. The trench is prepared in four grader passes. The first two are regular blade cuts that remove excess dirt. Then the Domor road widener goes to work and, in two passes, produces a trench that is ready to take concrete without any hand cleaning or labor. The bottom is clean, precision level and compacted. The paving edge is clean, providing an excellent bonding surface. No undercutting is required and the pouring of excess concrete, as in previous methods, is eliminated. No forms are needed if not called for in specifications. Ulrich Products Corporation, Roanoke, Ill.

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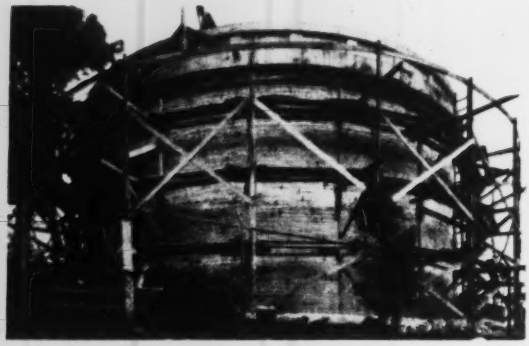

CEMENT GUN COMPANY PRE-STRESSES AND RESTORES *EXISTING* WATER TANK

The progress picture above shows a stage of operations in repair work on a concrete water tank in New England. The tank was completely lined with reinforced "GUNITE" to stop seepage which had caused serious disintegration to the exterior of the tank. The entire outside of the tank was subsequently chipped and existing bonds and reinforcing rods exposed.

To strengthen the tank, wedges were driven behind the rods to take up the slack. This placed the rods in tension and the concrete in direct compression. Wire mesh was then attached to the reinforcing rods and the entire tank treated with two inch mesh reinforced "GUNITE."

The use of "GUNITE" for repair and construction of sewers, bridges, buildings, etc., is illustrated and described in Bulletin B 2400. We will gladly send a copy at your request. On your letterhead please.

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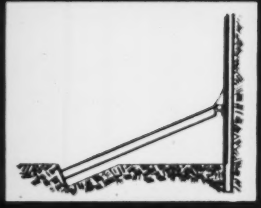

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Equipment, Materials & Methods (Continued)

Dial Type Thermometer

THE DILLON THERMOMETER was designed for use in checking temperature of hot asphalt when it is being laid. Checking the temperature of bituminous road building products is easily done with the instrument simply by pressing the stainless steel stem into the hot material. Temperature response is instantaneous. The standard instrument has a special handle casting so that this can be easily inserted in the material under test and easily removed. The thermometer is manufactured in many different ranges and is also available in a variety of stem lengths and with several different dial sizes. The model the company is standardizing for road building work is the Model R with a 3 in. dial, 9 in. stem length, and a range of 50-500 deg F. **W. C. Dillon & Company, Inc., 1421 South Circle Ave., Forest Park, Ill.**

Lead Holder

THE LATEST Koh-I-Noor push button operated lead holder with a scientifically designed knurling for sure, slip-proof tireless operation has been announced. This is the holder with "the perfect knurl in the proper position." The 5612 holder can be used with either Koh-I-Noor graphite leads or Flexicolor leads. The size of the 5612 holder is 5-3/32 in. which assures perfect balance at all times. The push button operation gives rapid, positive positioning of the lead which is held in a vise-like grip guaranteed not to slip. All parts of the 5612 versatile holder, including the chuck are easily disassembled and any necessary replacements will be made free of charge by the manufacturer. **Koh-I-Noor Pencil Company, Inc., Bloomsbury, N. J.**

Compressors

FIVE SIZES OF portable air compressors have been added to the company's line in a modernization program designed to better fit air compressors to the requirements of commonly used air tool combinations. The new capacities are 85 cfm, 125 cfm, 185 cfm, 250 cfm, and 365 cfm. Today's faster rock drills and more powerful paving breakers have exceeded the capacity of some of the standard ratings, while other standard sizes are, and will continue to be effective. Le Roi's wide range of sizes offers the air compressor user exactly the capacity he needs to operate a given number of tools at adequate pressure, yet not pay the penalty of excessive depreciation and other charges due to working with a compressor too big, and too expensive for the job. Le Roi now offers 60, 85, 105, 125, 185, 210, 250, 365, and 600 cfm models. Of these nine capacities, all but the smallest three can be supplied with Le Roi gasoline engines or International Harvester Company diesel engines. **Le Roi Company, 1706 South 68th St., Milwaukee 14, Wis.**

TIDE GATES

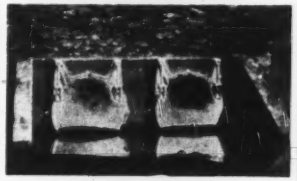

Fig. B-124-D
Two 60" Type M Gates on Relief Culverts near Woodward Pumping Station, Plymouth, Pa.

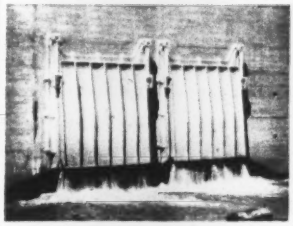

Fig. B-124-C
Two 72" x 72" Type M-M Gates on Toby Creek Outlet Works, Plymouth, Pa.

BROWN & BROWN, INC.
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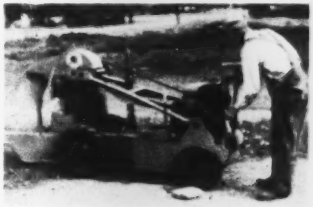
Equipment, Materials & Methods (Continued)

Trencher

A LARGER MODEL Ditch Witch, the Super E, has just been announced. Super E like other models, is self-contained. It operates under its own power to dig a trench to 6 in. wide, to a depth of 42 in.



Super E

Tests show this model will dig as many feet of trench as machines four times its size. Operating and maintenance costs are low. Ditch Witch trenchers have been used in practically every state by a widely diversified list of businesses. The Charles Machine Works, Perry, Oklahoma

Portable Loading Ramp

A REVOLUTIONARY PORTABLE loading ramp unit that enables one man to perform the work of ten, with push button control, has just been introduced. Portability and adjustability are the two outstanding features of the loading ramp. It can be installed in 5 min at any loading dock and its hydraulically operated deck adjusted to any truck bed height in a few seconds. Available in two models, manual and electrically powered, the ramp cuts loading costs by as much as 75 percent and effects a tremendous saving in time and labor. The electrically operated unit requires a 110 volt outlet. Another attractive feature of the loading ramp unit is an adjustable throw plate which can be easily raised or lowered for installation inside buildings without interfering with doors. The throw plate can be locked in horizontal position during loading, as can the deck, preventing accidental moving. The unitized power unit assembly of the Illo portable loading ramp consists of 110 volt, single phase ½ hp ball bearing drip proof motor directly connected to a 3 x 3 in. standard Viking 350 lb pressure hydraulic pump. Just plug into any light socket and the dock is ready to operate. John B. Illo Company, 2414 East 57th St., Los Angeles 58, Calif.

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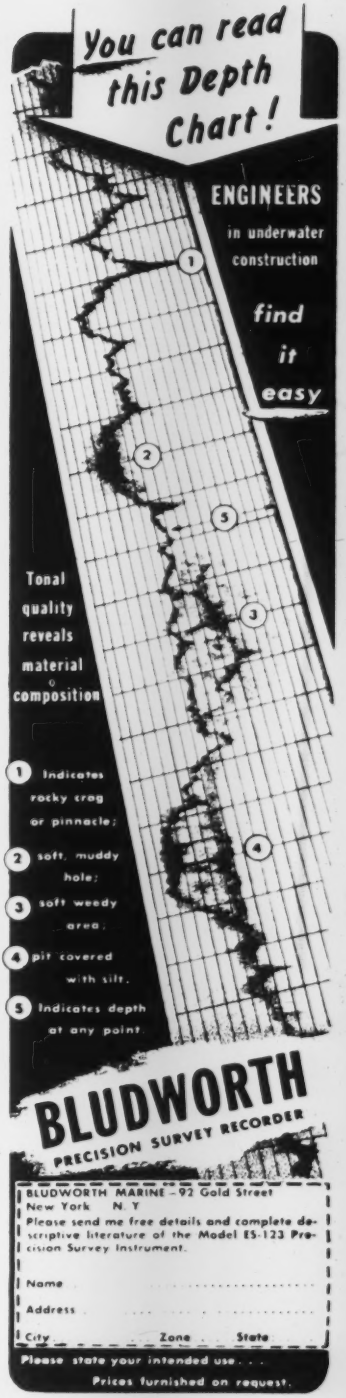
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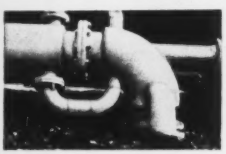

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Equipment, Materials & Methods (Continued)

Theodolite

THE TRANSIT T50 represents a low priced precision instrument enabling surveyors to cope with any possible problem of triangulation and to obtain results of the highest accuracy. On the old type transits, the horizontal and vertical circle readings have to be done from different positions, thus forcing the operator to walk around the instrument. The T50 eliminates this loss of time. All readings are done from one position. Both circles are read through the same microscope. There is no longer any danger of moving the instrument as the operator stands in front of it all the time. The time factor is also important. On the T50 the reading takes less than half the time required by all former types. This instrument is of the highest accuracy and absolutely safe against atmospheric changes. This is the only one equipped with a terrestric telescope, thus enabling every American trained surveyor to work with his accustomed device. Moreover, a built in optical plummet increases the efficiency of the instrument. Furthermore, electric illumination makes continued operation possible even in the dark. Thus the surveyor can finish his job in the evening instead of returning the next day for only a few hours' work. **Geo-Optic Company, Inc., 170 Broadway, New York 38, N. Y.**

Construction Material

A CONSTRUCTION MATERIAL with many potential applications in the building trades was recently described. The material consists of tiny glass balloons, about the size of grains of sand. Trade named Kanamite, the material is a fine-grain lightweight aggregate made by blowing up individual grains of clay in a special furnace. Concrete mixes using the new material in place of sand or other aggregates are very fluid, even though water content is low. This fluidity means that for the first time in building history—contractors can fill forms with concrete pumped through rubber hoses. Construction costs can be lowered because of the virtual replacement of shovels and awkward metal hose now used. The inherent strength of the material has been demonstrated by making plaster specimens with it that show a compressive strength greater than that of specimens made with sand. The high strength of plaster made with the new aggregate will allow thinner coatings of plaster to be used on walls than are now possible. Being strong as well as light, the relatively thin layer of the plaster is able to support its own weight. The material has potential applications in addition to concrete, mortar, and plaster mixes. As an ingredient of baked clay products it should make possible lightweight refractories and high-temperature insulating materials. It has almost unlimited possibilities as a filler in plastics and road-building materials. **Kanium Corporation, 322 South Michigan Avenue, Chicago, Ill.**

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PORTABLE ASPHALT PLANT—The Little Monster portable asphalt paving plant designed for fast moving, fast set up and high daily production, is described in Bulletin No. LM-1. Specifications, engineering data and other information is included. Madsen Iron Works, Inc., P. O. Box 589, Huntington Park, Calif.

WELDING—A booklet of 32 pages contains reprint of material from the "Procedure Handbook of Arc Welding Design and Practice," and was published so as to make this information more generally available. It covers welding of chromium-nickel steels, with and without molybdenum, as well as the welding of straight chromium steels, together with complete procedures. Contains analysis of most of the types of such steels. Also gives A.W.S.-A.S.T.M. classifications of corrosion-resisting chromium and chromium-nickel steel welding electrodes (Specification A298-48T). Price 25c, postage prepaid. The Lincoln Electric Company, 22801 St. Clair Ave., Cleveland 17, Ohio

RESEARCH AND ENGINEERING—A 12-page booklet entitled, "Engineered to Perform" is offered. The reader is presented with a pictorial inspection of research and engineering operations. Special tests and experiments are pictured and described. Experiments are matched against operating conditions to show the comparison. Strain tests on parts, tractor and engine laboratory work, fuel injection analysis, proving ground operations, "cold room" experiments at 65 deg below zero—these are a few of the topics treated in the booklet. Caterpillar Tractor Company, Peoria 8, Ill.

WET PIT PUMPS—A bulletin, No. 3-S800, covering two similar but functionally different types of vertical, centrifugal, wet-pit pumps; a heavy duty bilge pump for handling solids-free liquids and drainage; and a screenless sewage ejector, constructed to handle sewage and solids-carrying liquid, is available. This bulletin also introduces the Lubric-Vac system, a lubricating system which provides continuous positive lubrication of the pump bearing, reduces bearing failure up to 95 percent, increasing the over-all pump life by 12 percent. The Yeomans Brothers Company, 1999-A N. Ruby St., Melrose Park, Ill.

PUBLIC UTILITY BROCHURE—An attractive and informative brochure entitled, "A Study in Progress" is now available. Prepared for the public utility industry, it is the unusual case history of how one major public utility is meeting the problem of reducing costs and increasing worker productivity in a phase of operation important to all—handling, storing and warehousing the huge volume of supplies and equipment essential to day-by-day utility functioning. Featured are a great many photos of industrial trucks in actual operation. Hyster Company, 2902 N. E. Clackamas St., Portland 8, Ore.

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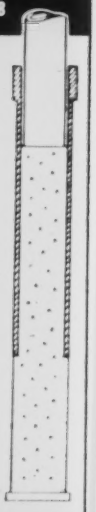

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Literature Available (Continued)

TRENCHMASTER. A 6-page bulletin recently issued, describes the Pipeline Trenchliner, for mile-a-day cross-country trench production. Designated as the Model 215, this wheel-type unit digs in a range of 30 digging feeds from 0.2 in. to 18 in. ft per min, 13 ft-cut in wide and up to 6 ft deep. A series of actual field photographs, included in the bulletin, demonstrate other features. Parsons Company, Newton, Iowa.

CONTROL INSTALLATIONS. An 8-page Bulletin, E-5265, outlines a technique for use in designing economical automatic electric control installations for heating and air conditioning systems. Central Control Panel technique simplifies installation, reduces over all costs, minimizes service, increases system flexibility, and assists engineers in preparation of specification drawings. Barber-Colman Company, Rockford, Ill.

CORROSION RESISTANT COATINGS. Two folders are available on protective coatings. One is on Ricwilite 1000 Phenolic Resin Coating and the other on Ricwilite 7300 Phenolic Resin Coating. The coatings are specially formulated to protect equipment against extremely corrosive conditions in all types of industry with a tough, impervious film which is resistant to attack by corrosive acids and alkalis, salt water, rust, and weathering. The coatings are ideal for protection of ventilating and duct systems, drill pipe, piping and equipment in food and chemical process plants, oil refineries, etc. Ric-Wil Plastic Coating & Mfg. Corp., 1290 Euclid Ave., Cleveland 15, Ohio.

MAINTENANCE CHART. Just released is a handy and helpful chart for service and maintenance of Galion Models 118, 110, 104, 103, 102, 203 and 202 motor graders. It treats both the subjects of proper lubrication and adjustments. Among the parts covered are the hydraulic system, steering controls, clutch, drawbar and circle, fuel system, brakes, etc. Also included is a complete list of distributors where Galion parts and service are available. The Galion Iron Works & Mfg. Co., Galion, Ohio.

BANTAM BACK HOE. An illustrated folder covering the 3-yd. truck mounted back hoe has just been published. The folder includes detailed engineering information on mechanical features, together with a large, easily read chart showing dimensions and operating data for the Bantam hoe, which is said to dig up to 100 ft of 3-ft trench per hr, with a maximum working depth of 14 ft. The folder also includes specifications on the company's interchangeable 2-ton crane adaptor and two types of backfill blades which permit complete handling of the job of pipe unloading, trenching, placement and backfill with one machine and one operator. Schield Bantam Company, Waverly, Iowa.

SEALED PROPOSALS FOR THE PURCHASE OF NEW, UNUSED EXCESS MATERIALS BEING OFFERED FOR SALE BY PANAMA CANAL COMPANY will be received by Superintendent of Storehouses, Panama Canal Company, Balboa, C. Z., until 10:30 A.M. November 14th on Circular #24, part I; November 18th on Circular #24, part II (Refrigeration equipment parts; plumbing supplies); November 21st on Circular #25, part I (Chevrolet parts); November 25th on Circular #25, part II, (Diamond "T", Dodge, Plymouth parts), November 28th on Circular #25, part III (Ford, autocar parts); December 2nd on Circular #25, part IV (Intl. Truck parts, Gar Wood load packing truck parts, carburetors). Blanks and information relative to these offerings may be obtained from Panama Canal Company, 24 State St., New York, N. Y.

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PROCEEDINGS AVAILABLE

The following papers, printed as Proceedings Separates, may be ordered on the basis of summaries given in this and previous issues of CIVIL ENGINEERING. Discussions of these papers will be received, as in the past, for a period of five months following the date of issue. A summary of each paper appears in several consecutive issues; other titles will be added every month, as they become available. Use the convenient order form on page 112.

Summarized in Earlier Issues

D-87. Discussion of Paper, **Sewage Reclamation by Spreading Basin Infiltration**, by Ralph Stone and William E. Gather.

D-92. Discussion of Paper, **Experimental Investigation of Fire Monitors and Nozzles**, by Hunter Rouse, J. W. Howe, and D. E. Metzler.

D-96. Discussion of Paper, **Surface Curves for Steady Nonuniform Flow**, by Robert B. Jansen.

D-100. Discussion of Paper, **Forced Vibrations of Continuous Beams**, by Edward Saibel and Frilio D'Appolonia.

142. **Unconfined Ground-Water Flow to Multiple Wells**, by Vaughn E. Hansen.

143. **Electrical Analogy in Problems of Three Dimensions**, by P. G. Hubbard and S. C. Ling.

144X

144B. **Aerodynamic Stability of Suspension Bridges, Progress Report of the Advisory Board on the Investigation of Suspension Bridges.**

145. **Torsion of I-Type and H-Type Beams**, by John E. Goldberg.

146. **Electrical Analogies and Electrical Computers: Surge and Water Hammer Problems**, by Henry M. Paynter.

Third Notice

147. **The Delaware Memorial Bridge: Design Problems**, by Charles H. Clarahan, Jr., and Elmer K. Timby. One of the major suspension spans thus far constructed, this bridge emphasized the need for knowledge of the behavior of such structures in order that maximum economy in design may be attained. The provisions for torsional resistance in this bridge include a double lateral system. Design specifications are discussed in some detail. The solutions to problems inherent in the particular foundation conditions encountered are explained. Correlation of the design with model tests has proved helpful and these tests are being continued. (Available September 1)

D-84. Discussion of paper, **Longitudinal Mixing Measured by Radioactive Tracers**, by Harold A. Thomas, Jr., and Ralph S. Archibald. The original paper, published in August 1951, presented a method of determining the magnitude and effect of horizontal mixing in pipes and tanks as available to the engineer through the use of radioactive tracers. Discussers are: Conrad P. Straub and Donald A. Pecsok, Alfred C. Ingersoll, Harold A. Thomas, Jr., and Ralph S. Archibald. (Available immediately)

148. **Bank Stabilization by Revetments and Dikes**, by Raymond H. Haas and Harvill E. Weller. Aggravated by wide variations of hydrographic and physiographic elements, the problem of bank stabilization on the Lower Mississippi River has been found to be extremely complex. The solution of the problem is not wholly a matter of applying hydraulic formula nor is it simply a proposition of adopting structural design that has proved successful elsewhere. This paper presents the problems encountered and the evolution in the design of structures employed to modify the primitive stream for the purpose of securing effective flood control and navigation. (Available October 1)

149. **Industrial Waste Treatment in Iowa**, by Paul Bolton. Problems involved in the handling of industrial wastes contain phases peculiar to a given region, but many such problems are common experience everywhere. As in most of the states, this question has been of major concern for a number of years in Iowa, and is presented herewith to a larger audience as a challenge toward more generalized solutions. (Available October 1)

150. **East St. Louis Veterans Memorial Bridge**, by A. L. R. Sanders. Some of the problems encountered in designing this bridge were of particular interest and importance. Their solution and the design procedure in connection therewith are explained. The cantilever river span is believed to be the longest of any span crossing the Mississippi. The AASHO specifications were departed from in the design of compression members and in determination of the wind load requirements on long spans. Other special features in the design were the bridge shoes, the floor beam hangers, and provisions for the lateral bending of floor beams. (Available October 1)

151. **Topographic Mapping in Kentucky**, by Phil M. Miles. Modern methods of topographic mapping have been employed in an unusually extensive cooperative program between the Commonwealth of Kentucky and the United States Geological Survey. This paper describes the historical and technical facts which determined the techniques and specifications used. Use of the equipment and the filing and distribution of topographic data, with emphasis on the value of by-products, is

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explained. The work in Kentucky is of particular interest to engineers or state officials considering topographic mapping in their own state. (Available October 1.)

152. **Methods for Making Highway Soil Surveys**, by K. B. Woods. Important developments and refinements in methods for making highway soil surveys include the use of agricultural soil survey maps, certain types of geologic maps, and air photos. Resistivity methods and seismic methods are useful for obtaining additional detailed information. Knowledge of geology, pedology, and aerial photography is important in interpreting the data obtained from these sources. The future need for specialists trained in the new techniques is foreseen as applying particularly to soils sections of the larger highway departments. (Available October 1.)

153. **Characteristics of Fixed-Dispersion Cone Valves**, by Roy V. Ribler and Gale B. Dougherty. This paper reports the results obtained from field tests on five Howell-Bunger type valves that have been installed by the Tennessee Valley Authority. A usable method is described for obtaining accurate discharge ratings with a minimum discharge through the valves. Rating curves and discharge coefficients are given. The results of measurements of the air required to vent these valves are supplied and the effects of the dissipating structures that surround the valves lead to the formation of ideas of the mechanics of air demand. (Available October 1.)

Second Notice

154. **A Navigation Channel to Victoria, Tex.**, by Albert B. Davis, Jr. This paper explains the authorization of a Federal barge channel and describes the planning of the channel prior to construction. The planning involves studies of both a lock canal and a sea-level canal, and requires a comparison of the engineering and economic features involved in the two types of navigation improvement. The problem of water supply for operation of a lock canal is investigated, and the effect of an insufficient water supply on design of a navigation channel shown. (Available November 1.)

155. **Field Study of a Sheet-Pile Bulkhead**, by C. Martin Duke. Measurements of soil pressure, tie-rod tension, and deflection were made during and after filling behind a bulkhead retaining a 55-ft fine sand fill. During filling, soil pressure on the bulkhead was proportional to the weight of overlying fill, in the ratio of about 0.7. After completion of filling, partial support of fill on the tie rods and anchor system was found to redistribute markedly the soil pressures. The results are interpreted in the light of special conditions, such as the presence of a granular dike. (Available November 1.)

156. **Rice Irrigation in Louisiana**, by E. E. Shutts. Interesting and valuable data on one important type of irrigation are offered for discussion in this paper. The author presents a brief history of rice irrigation throughout the world as a background for a detailed discussion of procedures followed in Louisiana. (Available November 1.)

D-78. Discussion of paper, **River Channel Roughness**, by Hans A. Einstein and Nicholas L. Barbarossa. This paper, published in July 1951, discusses the total friction developed on the alluvial bed of a natural river which can be described as the sum of a "surface drag" and of a "shape resistance." Discussers are: F. Blench, James J. Doland and Ven Te Chow, Robert B. Banks, L. Bajornas, and Sir Claude Inglis. (Available immediately.)

D-109. Discussion of paper, **Final Foundation Treatment at Hoover Dam**, by A. Warren Simonds. The original paper, published in December 1951, described the unprecedented height of Hoover Dam with the extremely high head of water against the foundations and abutments which created problems in design that were not subject to exact analysis. Discussers are: James B. Hays, V. L. Minear, Byram W. Steele, William H. McAlpine, Fred H. Lippold, O. E. Boggess, H. Cambefort, and A. Warren Simonds. (Available November 1.)

First Notice

157. **Radial Impact on an Elastically Supported Ring**, by Edward Wenk, Jr. The response of a circular ring that has radial and tangential elastic support and is subjected to a radial impulse has been investigated both theoretically and experimentally. Equations are developed for the frequencies of rigid body motion and flexural vibration, and infinite series solutions obtained for displacements and bending moments produced by an impulsive load. The validity of the theory was investigated by tests of a ring radially supported by springs and given an impact loading by means of a pendulum. Measurements were made of strains, displacements, and impact loading and also of the natural frequencies of flexural vibration. The experimental and theoretical results agreed very favorably. (Available December 1.)

158. **Flexure of Double Cantilever Beams**, by F. E. Wolosewick. Two cantilever beams at right angles to each other and joined rigidly at the apexes are analyzed for various loading conditions. Additional equations for variation of included angle and effect of shear are developed for special loading conditions. Warping of sections due to torsion is not considered, as being of secondary effect. (Available December 1.)

D-108. Discussion of paper, **Control of Embankment Material by Laboratory Testing**, by F. C. Walker and W. G. Holtz. The original paper published in December, 1951, describes the laboratory procedures for standardizing the testing of material to be used in embankments of the earth dam structures, and also their applications and correlation with field data. Discussers are: George F. Sowers, D. P. Krynine, D. E. Glynn, and F. C. Walker and W. G. Holtz. (Available December 1.)

D-113. Discussion of paper, **Wave Forces on Breakwaters**, by Robert Y. Hudson. The original paper, published in January, 1952, reviews the common theories for determining the magnitude and distribution of wave forces on vertical walls and sloping, rubble-mound breakwaters, and compares these theories. Discussers are: Kenneth Kaplan, R. G. Hennes and C. E. Leonoff, and Robert Y. Hudson. (Available December 1.)

D-115. Discussion of paper, **Lake Michigan Erosion Studies**, by John R. Hardin and William H. Booth, Jr. The original paper, published in February, 1952, deals with the erosion conditions, prior corrective actions, and structures and describes the protective measures that have been recommended for Lake Michigan within the State of Illinois. Discussers are: Thomas B. Casey, Charles E. Lee, and John R. Hardin and William H. Booth, Jr. (Available December 1.)

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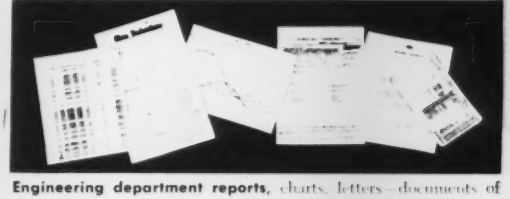

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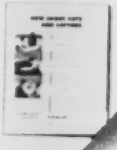

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